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MUNICIPAL ENGINEERING

VOLUME XXXVII. AUGUST, NINETEEN HUNDRED NINE. NUMBER TWO

CONSTRUCTION PLANT EMPLOYED ON THE NEW YORK WATER SUPPLY.

By H. Prime Kieffer, C. E., New York City.

MACARTHUR Brothers and Winston & Co. brought a large amount of equipment and experience onto this work which had been employed and gained in similar constructions. Nearly all of the plant and temporary constructions are, therefore, installed on a scale much larger than would ordinarily be considered requisite for work of this magnitude, in order to provide not only for the severe progress requirements of the official schedule, but to secure the highest quality and greatest rapidity of the work that is possible, irrespective of the contract specifications. Hundreds of thousands of dollars' worth of plant has been installed, a large quantity being of special design or construction intended for this particular work, and, in many cases, chargeable exclusively to this contract. The estimated value of the total plant is about $1,500,000.

For the execution of the work, the principal equipment includes four great cableways and a derrick system for the Olive Bridge dam, a stone quarry and several sand pits, excavating and transporting plant for the construction of cuts and fills, rollers for compacting the embankments for the dikes and dam, derricks, steam shovels, pumps and other standard machinery, a large power plant and distribution service, two systems of water supply and distribution, a sewage disposal system, an extensive railroad service, dump wagons, a large stone-crushing plant, a concrete-mixing plant, concrete cars and handling apparatus, a complete yard with molds and facilities for casting and handling 200 cubic yards of concrete block per day. It was, of course, necessary to provide a camp organization with provisions and other improvements on a large and extensive scale calculated for the safety, comfort and welfare of a great body of men for several years, and equal or superior in many respects to excellent municipal systems.

The four great cableways were built by the Lidgerwood Manufacturing Company, and, together with a row of powerful stiff-leg derricks, were installed parallel with the axis of the dam, and they handle all materials of excavation and construction, including, of course, the concrete. The cableways have a span of 1,530 feet with a 15-ton capacity. The towers for these cableways are about 95 feet high and are constructed of first quality pine timber from 12 by 12 inches down. About 60,000 feet were employed on them. The cableways and all other hoisting engines and apparatus, pumps and other standard machinery, except the steam shovels, locomotives and remotely attached plant, are being operated by compressed air. The air is furnished by two Ingersoll-Sargent compressors, delivering 500 cubic feet of free air per minute. A complete machine shop has been erected, as well as a smith shop equipped with steam hammers, bending machine and four blasts. Power is furnished by a 65-horsepower General Electric engine also operating a General Electric dynamo, furnishing 600 lamps. A carpenter shop, tool house and supply storehouse, 32 by 125 feet, were built. The quarry is located about one mile west of the Olive Bridge dam. The standard-gauge track leads from the crusher house to it and crosses the Esopus Creek on a steel-girder viaduct 1,200 feet long.

The rock found here is an outcropping of bluish-gray sandstone and is

stratified in approximately horizontal layers about 3 or 4 feet thick. A Model 45 Marion shovel was used in stripping the quarry face.

The Olive Bridge dam will contain about 550,000 cubic yards of concrete and a facing of molded concrete blocks. It is desired to put the dam in service at the earliest possible date and the construction and mixing plant have, therefore, been in excess in size of those often installed on similar public works.

In a single frame building, 80 by 100 feet by 65 feet high, are carried on the operations of crushing the stone, handling and storing the materials and mixing the concrete and putting it on the work. The working platforms are at different elevations, and the sand, cement and broken stone are stored at the top of the building and it is sent by gravity through the measuring devices to the mixers, which receive the charges from above and dump them below. The conveying machinery is all belted from two main shafts driven by a 250-horsepower Chandler & Taylor engine. The steam comes from the boilers located in the main power house, about 150 feet away.

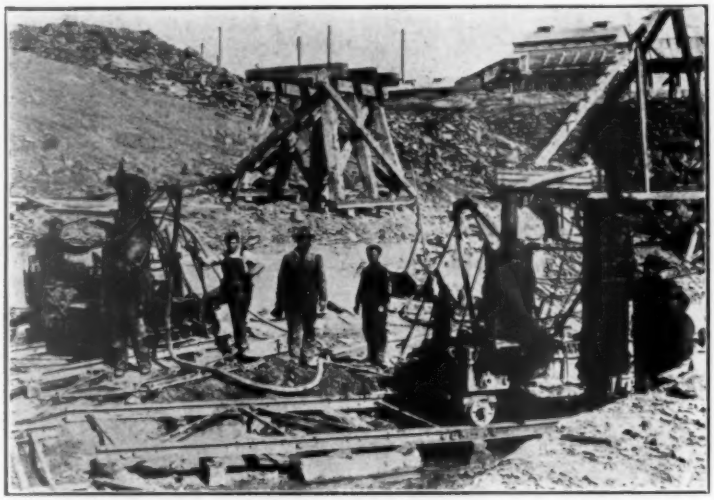
There are installed on the ground floor of this building two No. 6 Austin and one No. 9 McCully rock crushers with a total capacity of about 200 cubic yards of stone per hour. The stone comes to the crushers direct from the quarry and is delivered to them from the surface track by stiff-leg derricks. The stone is placed in 4-yard steel skips in sets of four, on flat cars at the quarry. The crushers discharge into 48-inch screens, 16 feet long, which separate the screenings less than ¼ and more than 2 inches. The concrete stone is raised to the top of the building by a link-belt conveyor about 90 feet long. It has 24 by 30-inch open-top steel buckets and runs at a speed of 85 feet per minute. The stone from this conveyor discharges into a chute which delivers it to two 30-inch link-belt horizontal conveyors which run the full length of the building and which in turn deliver the stone to the storage bins. The screenings are sent through a chute to a conveyor belt below the crusher floor, which discharges them on the sand belt. The stone larger than 2 inches is sent on a conveyor to the No. 6 crushers.

Sand is brought from the pit in 7-yard Western side-dump cars and dumped in a storage bin of about 500 yards capacity, made by an excavation just outside of the crusher and mixing plant. The sand is delivered by gravity to a belt conveyor, which carries it to a bucket elevator discharging at the top of the building to the distributing conveyor of the storage bins. The stone and sand bins are about 15 feet deep and 100 feet long, separated by a timber wall. They have a capacity of 1,000 yards of stone and 500 yards of sand, and they are 24 feet above the ground at their lowest point.

The Alsen and Giant Portland ce-

NEW YORK WATER SUPPLY.

Crusher and concrete mixer building. The four tracks in the building place cars directly under the concrete mixers. The derricks transfer the large stone from the cars to the crushers.



NEW YORK WATER SUPPLY.

Channeling machines cutting out core for Olive bridge dam. Concrete-mixing plant in background.

ment used is delivered in bags to the storage house, whence it is sent as desired to the mixer hoppers by a 24-inch conveyor. The stone and sand are taken from the bins through steel gates onto conveyors which deliver to the pyramidal steel charging hoppers in any quantity desired.

The concrete used runs from 1-2.7-5 to 1-3-5, and requires 14 bags of cement for each 2½-yard batch. The water is taken through a valved pipe from a cylindrical steel tank nearby, and the amount is determined by the concrete inspector. The water is added only while the machine is in operation and it is sent through perforations in the hollow axis. The four mixers used are 2½-yard Ketenbach & Creis cubical type, and each can deliver thirty 2½-yard batches an hour. They discharge into Cyclopean bottom-dump buckets made by the G. L. Stuebner Iron Works. These buckets are placed in pairs on plank cars and are drawn by mules directly beneath the mixers. Four lines of track lead to the concrete block making yard and four lead to the four main Lidgerwood cableways. Up to the present, the plant has not been operated to its full capacity, about 1,200 yards being used on the dam and about 200 yards in the block yard, per day.

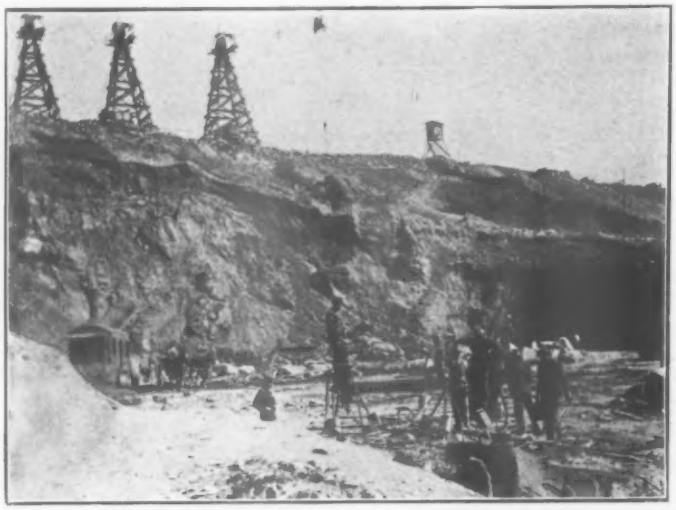
The concrete blocks are being placed on both the upstream and downstream faces of the dam, and between 45,000 and 50,000 blocks will be used in this work alone. The blocks contain about 1 1-3 cubic yards of concrete and their height depends upon their position in the dam, those at the bottom being 2 feet 9 inches high, while those in the middle and top have a height of 2 feet 6 inches and 2 feet 5 inches respectively. Generally the blocks are rectangular, excepting those in the downstream face of the dam and they have one beveled surface. These beveled surfaces, as well as all surfaces exposed in the faces of the dam, are made against steel-lined sides of the molds. The concrete-block casting yard adjoins the mixing plant. The concrete is taken from the mixers to a movable platform in the yard and it is then shoveled by hand into the forms, the platform being drawn to the location of the molds. A force of fourteen men has made as high as seventy-five blocks in one 8-hour day. The molds are sometimes removed from the blocks in thirty-six hours' time. The sides and ends (if they may be so called) of the molds are simply dropped flat and the blocks are hoisted by derricks and stacked to await their disposition in the dam.

About 3,000 workmen, mostly unskilled laborers, including negroes, Poles, Italians and Slavs, are at work in the vicinity of Brown's Station. At the Ashokan Dam camp there is a daily house-to-house sanitary inspection, with removal and incineration of refuse. The sanitary regulations are posted on the trees along the streets in all languages spoken in the camp. There is a hospital with two doctors, who also have free dispensary hours,

and there are three trained nurses. There is an adequate water supply, with a filtration plant. There are also a commissary department, a bakery, a cold storage plant, eating houses, clean workmen's cottages, a poolroom and an engineers' club. A schoolhouse has a day school in three grades, a kindergarten for the camp children, and a night school in which English is taught to the workmen. A school, garden and a band are other features of camp life.

There are very few cases of contagious diseases, and this is of course due to the excellent quarters and sanitation provided by the contractors.

The Ashokan Dam and reservoir, the aqueduct and accompanying works were designed and are being constructed under the supervision of the Board of Water Supply of the City of New York; Messrs. J. A. Bensel, Chas. M. Chadwick and Chas. A. Shaw, commissioners; Mr. J. Waldo Smith, chief engineer; Mr. John R. Freeman, Prof. W. H. Burr and Mr. Frederick P. Stearns, consulting engineers; Mr. Alfred D. Flinn, department engineer, headquarters department; Mr. C. E. Davis, department engineer, reservoir department, and Mr. J. S. Langthorn, division engineer. The general contract for the dam and dikes was awarded to MacArthur Brothers & Co. and Winston & Co. Mr. M. J. Look is the general superintendent for the contractors. Mr. F. H. Trow and Mr. Harry A. Briggs are engineers, and Mr. C. H. Peters, master mechanic for the contractors. The T. A. Gillespie Company have the contract for constructing the Rondout siphon, and other contracts are still to be let.



NEW YORK WATER SUPPLY.
Rock drills at work on foundations of Olive bridge dam, steam shovel, cables and cable-way towers.

TESTS OF PAVING BRICK.*

By Prof. A. N. Talbot, Illinois University, Urbana, Ill.

THE rattler test was described in full last month. Following are discussions of other standard tests of paving brick:

*From Bulletin No. 9 of Illinois State Geological Survey.

ABSORPTION TEST.

There has been a change of view in reference to the value, applicability and purpose of the absorption test. In the early experience with brick pavement, soft and porous brick were used,

and the fear was expressed that the brick would crumble and disintegrate under the effect of a repeated freezing and thawing, and an absorption test with an arbitrary limit was included in the specifications. This test was used without full information of the properties of the brick and frequently without good judgment. The experience of years and tests made by repeatedly freezing and thawing bricks have established the fact that the action of freezing and thawing is not likely to disintegrate brick of a high grade which will pass the requirements of other tests. This statement should not be interpreted to mean that the action of frost and traffic together will not cause disintegration of brick which, when dry and cold, would resist the wear of the traffic fairly well. The improper use of the absorption test resulted in an indiscriminate condemnation of it, and also in a lack of appreciation of its value and usefulness as an auxiliary test and as a means for studying properties of the brick. The absorption test is a valuable adjunct for use in interpreting the results of the rattler and cross-breaking tests and in studying the peculiarities of the particular make of brick which will be put into a pavement.

A good paving brick will absorb water quite slowly, the rate of absorption varying from hour to hour. Fig. 1 shows the rate of absorption through the period of some days, as given by Mr. F. F. Harrington. If the outside of the brick is more dense than the interior the rate of absorption is still slower. A broken brick or a rattled brick will absorb water more readily than whole brick, for this reason, and such brick should be selected for the test. In some tests the brick have been partially submerged for some time to allow the escape of air. The absorption of water is more rapid in the beginning, is quite slow after twenty-four hours, and still slower after forty-eight hours. The absolute value of the absorption power is not required, and for comparative purposes the result at the end of twenty-four hours, or better, at the end of forty-eight hours, will be sufficient. Brick which absorb but a small part of their final amount are usually so dense that the total absorption would be very small and the variation in value for such brick will not affect comparisons. Since brick in their usual condition contain some moisture, the sample should be dried for several hours at a temperature at or above the boiling point of water. The method given below requires forty-eight hours, but this protracted period seems unnecessary for ordinary purposes.

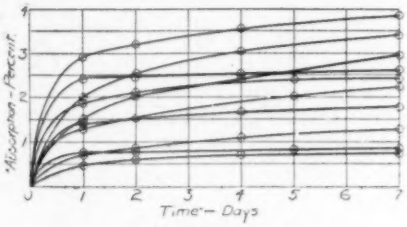


Fig. 1.

RATE OF ABSORPTION OF PAVING BRICK.

The absorption test should be conducted under the following conditions: The test will be made on five brick which have been exposed to the action of the rattler, or, if these are not available, on five brick which have been broken into halves. The brick shall be dried at a temperature of 200 degrees to 300 degrees F. for twenty-four hours, and then, after weighing, shall be immersed in water for forty-eight hours. Before reweighing the brick, surplus water shall be wiped from its surface. The absorption shall be expressed in per cents of the dry weight of the brick.

The idea that low absorption is a guaranty of excellency of the wearing qualities of paving brick was held by engineers for many years. As brick are burned in the kiln, the amount of their porosity becomes less and less until a point is reached when another change occurs and further burning will not decrease the porosity. The absorption test may determine or distinguish underburned brick, but overburned brick may not give a test much different from brick which have received the best degree of burning. The best limits for absorption will vary with the clay and method of manufacture and will have to be determined for every make of brick. This determination may be made by comparison with the results of other tests and by experience with the brick. In other words, no general limits can be placed for the absorption test, but special limits may be specified for particular makes of bricks used in any city. For a given brick, then, it may be said that the absorption test is able to distinguish underburned brick, and that it will be helpful in determining the length of burning permissible with a given grade and make of brick.

CRUSHING TEST.

Tests for crushing strength are open to the objection that the results obtained are extremely variable, especially as the methods of making the tests are not uniform. When the faces of the test cubes are ground accurately to plane surfaces, the results with high-grade paving brick are very high, running up to 20,000 pounds per square inch. The use of prepared test cubes makes an expensive and slow method of testing. Whole brick or half brick are tested on edge, sometimes with the bearing faces ground and in other cases not. If not ground, the faces may be bedded in plaster of paris and crushed after the plaster has fully set, or the faces may be bedded in cardboard or heavy paper. The last named method of testing is more readily made, and if at least five specimens are tested, the average may be expected to give representative results. Soft brick will give results as low as 1,000 pounds per square inch. It may be expected that overburned or poor paving brick will stand a load up to 3,000 pounds per square inch. Good pavers will range between 6,000 and 12,000 pounds per square inch.

Crushing strength is a desirable property in a paving brick. The argument that such heavy loads as are indicated by crushing values will not come upon the brick, and that the brick will not be crushed in the street is a negative one. There is a relation between crushing strength and hardness. The stronger the brick the better it will resist wear in the pavement. This quality of strength is particularly desirable where pavement is subject to heavy traffic. In comparing two bricks giving about the same rattler results, the one with high crushing strength will stand heavy traffic much better than the weaker one. For light traffic high crushing strength is not essential. It is further true that the crushing test throws light on other physical properties of a brick and is a source of evidence in the study of quality. Generally speaking, however, this test is not of a character to be included in specifications, but it is of value in connection with the study of the properties of different bricks. It will be seen, also, that the cross-breaking test gives information which may permit it to take the place of the crushing test.

CROSS-BREAKING TEST.

The cross-breaking test is for the purpose of determining the general strength of the brick; incidentally it gives evidence of the toughness and the hardness of the brick. It indicates the ability to resist cross-breaking, twisting or spalling by concentrated loads, and is an index of the crushing strength of the brick.

Two objections to this test have at times been raised: (1) That the quality indicated by the test is not needed in a paving brick, and (2) that the results of the cross-breaking test are variable and even erratic. It is believed, however, that the test is helpful in judging of the quality and strength and toughness required of a good brick. It may be sufficient to specify only a medium value for the modulus of rupture, and yet a brick with a fairly high value will be of higher grade. The brick which does not have the quality of high resistance to cross-breaking is likely to spall or break in the street and not to withstand traffic, even though the rattler test may show a low loss. Brick which have the toughness and strength

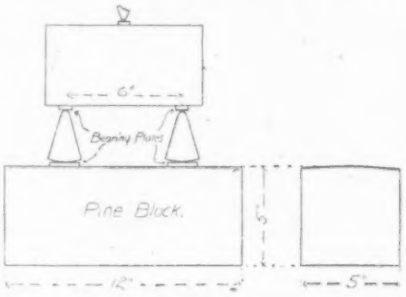


Fig. 2.

ARRANGEMENT FOR TESTING CROSS-BREAKING STRENGTH OF BRICK.

which go with a good modulus of rupture may show a somewhat higher loss by the rattler and yet give better results in the street than other brick whose rattler losses are lower. It must be expected that there will be a variation in the results shown in tests of individual brick, for quality varies considerably in ordinary paving brick. The rattler tests of individual brick vary widely. Much of the variation which has been reported in the results of cross-breaking tests is due to the method of making the test commonly employed. It is believed by the writer that the method here given reduces the variation due to the method to a reasonable amount, and that the variation now found represents quite closely the lack of uniformity in the brick. With the test made in the manner here described, cross-breaking tests, if properly judged, become a valuable adjunct in the determination of the qualities of a paving brick.

Brick should be tested as a beam on edge, with a span of 6 inches and with the load applied at the middle of the span. The modulus of rupture is determined by the usual formula:

$$S = \frac{3}{2}\frac{Wl}{bd^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where W is the load applied, l is the span, b is the breadth of the brick, and d the depth.

Fig. 2 shows details of testing blocks. Attention is called to the use of steel bearing plates and to the use of the wooden block. The narrow, soft steel plate gives a bedding on the brick which is slightly adjusting and overcomes the tendency to cutting. The knife edges are slightly curved in the direction of their length, to allow for irregularities or warping in the brick. The lower knife edges rest upon a wooden block, which is curved laterally somewhat to allow a rocking movement. The main purpose of the wooden block, however, is to allow adjustment by its compression, so that the load will be more evenly distributed and so that the work of applying the load and making the test will extend over a longer time. This arrangement allows a more accurate determination of the amount of the load and greater freedom in making the test. The results of tests show that this method gives results well within the range of uniformity of the brick. Requirements for the cross-breaking test should specify that the brick be tested on edge, that the span be 6 inches, that the knife edges be slightly curved in the direction of their length, say with a radius of 20 inches, and that the test be made upon a wooden block similar to the one shown.

SPECIFIC GRAVITY.

The test for specific gravity gives general information, but is not of service for general use. The specific gravity of a brick depends upon the material, the method of making and the amount of burning. For certain clays and processes the specific gravity of a brick depends upon the amount of burning, up to a certain point, which varies with different clays. A dense, heavy brick has a high specific gravity. The range of specific gravity for shale paving brick is from 2.2 to 2.4. In making tests of specific gravity the amount of water absorbed by the brick must be allowed for. The brick is weighed in air and then in water, and again in air. Then the specific gravity may be determined by the formula:

$$\frac{W}{W'-W''}$$

where W is the weight of the dry brick, W' is the weight of the saturated brick in air and W'' is the weight of the saturated brick in water.

THE VALUE OF WATER.

By Alton D. Adams, Consulting Engineer, Worcester, Mass.

GREAT sums are being paid to riparian owners for water taken for public supplies, where the water has been used to develop power.

A case in point is that of the Kettle Brook taking by Worcester, where some 5,000,000 gallons of water diverted from the Blackstone River each twenty-four hours was capable of developing about 1,000 horsepower as a total at the eighty mill privileges concerned, and was compensated by the payment of $500,000 as damages, or $500 per horsepower lost by the diversion.

The amounts of such damages and the opinions of the commissioners appear to indicate some strange misunderstanding by which the value of the power that might be developed, rather than the value of the water taken, has been adopted as the measure of damages. For such a substitution of the value of a possible product for the value of the water taken, there appears to be no justification in law or reason.

The general rule of compensation where water is taken under legislative authority for the public use has been thus stated by the Massachusetts Court:

"First ascertain what was the fair market value of the petitioners' mill, with its water rights appurtenant to it, and then ascertain how much its value has been diminished by the existence of this right of the town of Wohurn to use now in prospectivity the waters which would otherwise come to his mill. This diminution is the sum to which the petitioners are justly entitled as compensation." Cowdry v. Woburn, 136 Mass. 409, 414.

In the trial of cases to fix the damages to be paid for the taking of water for public use, the total value of the mill and water rights affected are often neglected, and the cost of generating with steam the amount of power lost by the diversion of the water, minus the cost of the water power, is offered as a measure of the damages; and this has the sanction of the courts as evidence, but not as a final test. On this point the New Jersey Court has said:

"In fixing the amount of depreciation in market value of the whole premises of the complainants, the amount of power to be produced at their mills by the water diverted, and its value to them for actual use, and the cost of reproducing it, are proper elements to be considered." Sparks Manufacturing Company v. Newton, 57 N. J. Equity, 367, 395.

Another line of evidence that is sometimes offered as a measure of the depreciation in the property affected is the market value of power in the vicinity of this property, as in the Kettle Brook case, and it is this evidence that is apt to lead to very illogical and unjust results, by the substitution of the value of power, the product, for the value of water, the element.

Water may be used for the supply of livestock, the dyeing and washing of cloth, the manufacture of bricks or of paper, or for the production of power, among other purposes, but in each case the value of the product is greater than the value of the water that goes to make it. If the water is used in the manufacture of cloth there must be yarn, if in the manufacture of paper there must be pulp, if in the manufacture of bricks there must be clay, and if in the production of power there must be hydraulic structures and machinery, besides the necessary land, buildings and labor.

If the water were taken from a farm, a brickyard, a cloth factory or a paper mill, it would be a strange proposition that the measure of damages should be the market value of all the live stock, all the bricks, all the cloth, or all the paper that could ever be produced by using it. How then can the damage caused by the diversion of water from a power plant be measured by the market value of all the power that could ever be developed by it?

Besides the value of the water used to develop it, the market value of power usually includes interest on the cost of the hydraulic structures, buildings and machinery, depreciation and repair charges, and current expenses for the labor and supplies incident to operation, plus some profit. If the power is not used at the exact point of production, the interest on the first cost of the electric plant or other means of transmission, plus the depreciation, repairs and other operating expenses of this plant, must be added to the like charges on the complete hydraulic equipment, to obtain the market value of the power, unless the total cost of power developed by steam or some other means is less than that of water power.

The result is that the market value of water power is far higher than the market value of the water used to develop it, just as the market value of steam power is several times the market value of the coal burned under the boiler to produce it. While some riparian owners claim the market value of the power that might be developed, as compensation for diverted water, it would certainly be a new view that the damages for coal taken for public use should be measured by the market value of the power that might be obtained by burning it.

In their report of the Kettle Brook case, the commissioners, speaking of mills below the point where the water was taken by the city, said:

"So far as these properties are concerned, the petitioners claimed that inasmuch as the city had taken a certain amount of *power* from each mill, that was worth in the market so much per annum, the rule to be employed is to find the amount of *power* taken at each mill, multiply by its value per *horsepower*, capitalize at 4 per cent, and the same is to be treated as the damage so far as the loss of *power* is concerned. It is urged that this is the only just method, because that was what the *power* was worth in the market if sold in 1895, and the city must pay the market price."

The report of the commissioners did not state whether they had adopted this interesting claim of the petitioners as the basis of compensation, but one of the commissioners, a lawyer, subsequently stated their position on the matter, in a discussion of it before the American Society of Mechanical Engineers, Volume 21, Transactions, page 612. Referring to a large number of mills on the river miles below the point of diversion, where the water was only used for power, the commissioner said:

"Upon the practical agreement of

the parties, these properties were as remote that no other rule could be employed; we capitalized at a certain rate that we believed to be the going rate of *water-power* in the vicinity of these mills, and allowed the same as loss sustained by them in market value."

A search through the closing argument of the late Senator George Frisbie Hoar, senior counsel for the city of Worcester in the Kettle Brook case, has not disclosed any clear agreement that the compensation for the water taken should be measured by the market value of the power that such water might be used to develop. Neither is it clear why the fact that mills were located at points down stream remote from the place where the water was diverted should make it necessary to adopt the market value of the *water-power* that might be developed as the measure of compensation for the *water* taken.

The degree of success attained by the theory that the market value of the possible *power* development should measure the compensation for diverted *water*, in the Kettle Brook case, was probably due to a certain logical fallacy concealed in the questions of Counsel Goulding for the petitioners, which led experts for the city into damaging admissions, and which Senator Hoar failed to expose clearly.

A quotation from the cross-examination of one of the experts for Worcester by Counsel Goulding shows exactly how the assent of the witness was gained to a clever fallacy, and how he was thus led into a damaging position from which there was no safe escape.

"(1) Question. Would it affect your judgment if you assumed on a solid basis—did not have any doubts about it, that is, the hypothesis, that they rented the whole of it, all the *power* the mill produces for $75 a year, and that then, if the city came along and took away two or five *horsepower*, whether, in your opinion, the city should not pay what the others pay?

"(1) Answer. Now, I understand that the $100 per year is for the whole *horsepower*, and nothing to do with the land that the building is on, nothing for the use of the building or nothing extra, just the same as if the man got the whole of it?

"(2) Question. Yes.

"(2) Answer. Then I answer it would affect my judgment.

"(3) Question. (By Senator Hoar). I would like to ask one question in connection with that matter. Suppose the Slater mill, the hypothetical case you have just answered, rented this *horsepower* at $75 per year, would there, in your judgment or not, be any value to it beyond what the *water* saved in the production of steam power would be?

"(3) Answer. No, sir, not under my idea of the true market value.

"(4) Question. (Cross-examination resumed by Mr. Goulding). Not at all. I say assume that the horses are worth $100 apiece in Worcester. Somebody takes away the whole of them, no matter how many — takes horses from the man who owns them in Worcester; they are worth $100 in the market. My question is whether he should be paid the value of the horses here in Worcester, or $50, because he can produce them on his big ranch and get them to Worcester for $50 apiece? Now, don't you know that any man of common sense would know what they would be worth here in Worcester?

"(4) Answer. If he sold them on his ranch, he would get just about the same profit on his ranch as he gets here in Worcester at $100.

"(5) Question. (By Senator Hoar). Suppose anyone sells them for $100 there, would they be worth more than $50?

"(5) Answer. No, not on his ranch.

"(6) Question. (Cross-examination resumed by Mr. Goulding). Does the same theory apply to these clothing stores? A man comes in and takes a coat. Ought he to pay what it would cost the dealer to get it, or what it is fairly worth on his counter—the market price?

"(Remark by Senator Hoar). The dealer can send out and get another coat in a minute.

"(7) Question. (By Mr. Goulding). No matter. I ask you to eliminate the proposition whether he could get it for more or less. Why hasn't he a right to the fair market value of that property as it lies there?

"(7) Answer. To make a basis of the fair market value of that we are considering, we have got to go back to the fair profit on that coat.

"(8) Question. A man comes and takes and abstracts it, without right, by force, from the clothing dealer; and my simple question is whether he is entitled to the fair market value of that coat as it lies there, cost and profit too, or whether he is only entitled to the cost?

"(8) Answer. Well, if he could buy 1,000 coats cheaper of somebody else, he would buy them at that price. He can buy the whole of his *water-*

power—and this is only a part of it—this water-power for a great deal less than the cost of producing steam *power*, or what it sells for." (End of the cross-examination.)

To sum up the result of the above cross-examination, the expert was destroyed by his fatal admission that the city took *water power*, and by his effort to substitute cost of production for market value, and Senator Hoar fell into the same trap, judging by his interjected questions and remark.

There was testimony in the case for the petitioners that the owners of the old Slater mill used the first story as a cotton factory, developing their power with water, and rented five to fifteen horsepower to parties on the upper floor, at $75 to $100 per horsepower per year. On these facts the hypothesis of question (1) was based, but the fallacy in that question lies in its implication that the city had taken some *horsepower*, and the expert fell squarely into the trap by assenting to that implication in his answer. Counsel Goulding clinched his advantage by repeating question (1) with slight variations, and obtaining further assent to his assumption that the city had taken *horsepower*.

In reply to question (1), the expert might have saved himself and the city treasury by saying: "I deny that the city has taken any *horsepower*, or should pay for any *horsepower* at any price. The city has taken only water, and the value of the *water* is only a fraction of the value of the *power*, since *water* is only one of the several elements that go to develop *power*."

In question (3), Senator Hoar commits the folly of getting the expert to deny that *horsepower* which sells at $75 per year is worth that amount, or has that market value, and question (5) has the same object.

Having secured the assent of the expert to the fallacy that the city had taken *horsepower*, Counsel Goulding was able by questions (4), (6), (7) and (8) to show the absurdity of the proposition that the coat, horse, or *horsepower* taken from its owner should be paid for at its cost to him, rather than at its market value. At the end the expert was left committed to a proposition that probably no one in court except himself believed.

If the city of Worcester had fixed on the mill owners along the Blackstone the obligation to deliver a certain number of *horsepower* in perpetuity, the measure of compensation suggested by Counsel Goulding might have had some proper application, but all that the city took was *water*.

Before the close of the case, Senator Hoar denied the contention that Worcester had taken *horsepower*, for in his closing argument he said (see Record, pages 2836 to 2837):

"We have not taken any power whatever. His right, so far as we are concerned with it, is not a right to power. His right is to have a quantity of water enter his premises from above, to be discharged after such reasonable use as he may choose to make of it from his premises below. . . . That water, if it ever reaches one of these mills, is only one of the several elements out of which, if he chooses to take it in a particular manner, to connect it with particular mechanisms, to add to it the other necessary and essential elements and to make a large expenditure for this purpose, he can produce power. That is all."

Admirable as is this last statement of law and fact, it was not applied to demolish the force of the horse question of Counsel Goulding, for in the discussion of that question, at page 2848 of the Record, Senator Hoar says:

"We expect to pay him money enough to put his horses back or horses just as good back at the very place where he is selling them. . . . So he'll have just as many to sell and just as many to use as he had before."

So the case closed on the theory of paying the owner not the market value but the production cost of the thing taken.

STATUS OF SEWAGE DISPOSAL IN AMERICA.*

By Alexander Potter, Consulting Engineer, New York City.

IN certain particulars the problems in this country differ from those of English disposal systems described in the preceding articles, in many ways. We have been able to profit, and can profit still further, by both her failures and her successes. We have found that one of the great difficulties in the way of the correct solution of the sewage disposal ques-

*From an address delivered at Indianapolis, Ind.

Coke Preliminary Filters and Intermittent Sand Filtration at Houston, Texas—Side view.

The same as above, taken from tool house.

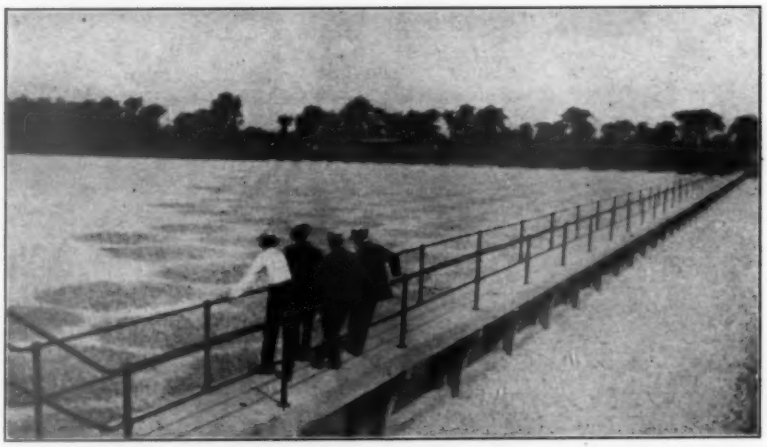
tion in England, is the complex and ever-changing character of the sewage. We are rapidly approaching the same degree of crowded centers of population and manufacturing plants producing the same conditions. England has spent far vaster sums upon sanitary works than America has dreamed as yet of spending, but we are facing conditions where such expenditures will become more and more necessary. Our waterways are becoming seriously polluted, the health of communities is threatened, and our esthetic tastes and pleasures are marred by unsightly shore and stream conditions. Three years ago the State of Pennsylvania created a State Board of Health and placed at its head Dr. Samuel Dixon, a physician and scientist of independent wealth. Dr. Dixon's slogan has been "Restore our streams to their natural purity." It has proved to be a popular cry and he has won the people of his State to him. His influence has spread wider than his State and he has been quoted throughout the length and breadth of the land with telling effect. This is a needed awakening and we should all work together to remove unsalutary conditions everywhere.

But first we should know more definitely what are unsanitary conditions, in other words, what constitutes proper sewage disposal? There are many conflicting ideas relative to the standard of excellence required of a sewage effluent before it is allowed to enter a stream, and these conflicting standards complicate our problems very greatly. The rulings of health boards in the different States are almost as different and widely varied as the well-known conflict in the divorce laws of the various States. This, on a scientific matter, is not necessary, and I do not believe will long remain the case. Some are decreeing that there must be a complete separation of sewage proper from surface drainage, so that every city shall be in a position to intercept all pathogenic germs before they enter the streams, whether used for water supplies below such point of discharge or not. If this theory is upheld, then many of our largest cities will be required to remodel or entirely rebuild their sewerage systems at vast, almost prohibitive cost. Others contend that this is unnecessary and that what are known as combined systems, carrying both the sewage and surface drainage to the point of disposal, except in times of storm, when they would be allowed to overflow into the nearest stream, are just as well fitted to meet the needs of our growing cities.

The Relation of the Sewage Disposal of One Town to the Purification of the Water of the Town Below.—No general rule has ever been nor ever can be set down that will do justice to every individual case. The sewage of each city is a law unto itself. There is no body or board of men that can formulate a set of rules for the guidance of all cities in the handling of their sewerage problems, but it is exceedingly important that certain conjoint action be taken in the various States upon the question of the relation of the sewage disposal of one town and the purification of the water of the town below. A rule regarding this relation can and ought to be formulated and it is of national importance that it should be. Until such a rule is formulated there must of necessity be doubt and confusion as to what should be required of a city in the way of sewage disposal with the correlative expenditure of revising its present system, which in some cases will involve its entire reconstruction. This is entirely too important a matter to be lightly disregarded.

Do not understand me as saying that any fixed set of rules can be drawn for the governing of all individual cases. I distinctly state that I do not believe that such a thing would be possible or right; but there are so many interstate questions constantly arising in relation to the control of the watersheds of our rivers and lakes and there are so many conflicting ideas regarding the extent of legislative control, that there should be some concerted action between the various State Boards of Health, and I would advocate very strongly the creation of a National Board of Health to advise and arbitrate in such matters.

The necessity of such review is apparent when we recall the fact that State lines require the consideration of the design of the sewerage system of one city in reference to the effect of the effluent on the water supply of a city in another State. Again, two cities of the same general character on opposite banks of a river which forms a State boundary, may be facing the problem of sewers and sewage disposal. The requirements of the State Board of Health may be more severe in one State than in the other. If one city is required to adopt a plan involving a larger expenditure of money and a higher degree of purification than the city on the opposite bank,



Columbus, Ohio. View of Sprinkling Filters in operation. This picture was taken when liquids were first passed through the filters.

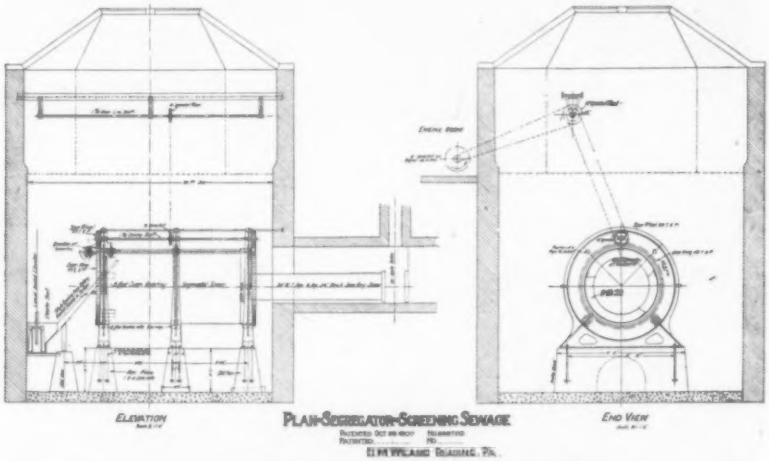
Vineland, N. J. Intermittent and Filtration Beds.

these are surely grounds for objection and demurrer.

Again, much can often be gained by concerted action between cities and towns in the same vicinity. The lack of concerted action between English cities strikes a stranger very forcibly, and there is no question but that much might have been saved in their experiments and construction had this phase of their situation been studied. There are many groups of cities in England of respectable size, say from ten to thirty thousand people each, and often larger, which maintain independent disposal plants in very close proximity —so close in fact that on one afternoon during the speaker's stay in England he walked to four different and important disposal plants in somewhat less than an hour. This is in most cases very wasteful, but the idea of combining the various works into one plant or under one management seems never to have been considered. This is a mistake which American towns in close proximity may easily avoid to mutual advantage. Perhaps the reason for this lack of combination in England is rooted in the very customs of the country. Those of you who have visited England can, of course, appreciate how much the customs are against free intercourse. This is true of their everyday, personal life. You know that unless you have made an appointment with a man in England several days prior to the time of your call upon him, it is next to impossible to be admitted to his presence, notwithstanding the fact that at the very time of your call he may be sitting in his private office with his feet on his desk, with nothing to do, and actually longing for some diversion. A visitor to English plants cannot help noticing the apparent almost utter lack of knowledge on the part of those in charge of one plant of what is going on in another even nearby plant. There seems to be little or no desire to profit by the experience or failures of other places. This is certainly not a characteristic of American engineers, who are only too eager and anxious to profit by the mistakes of others.

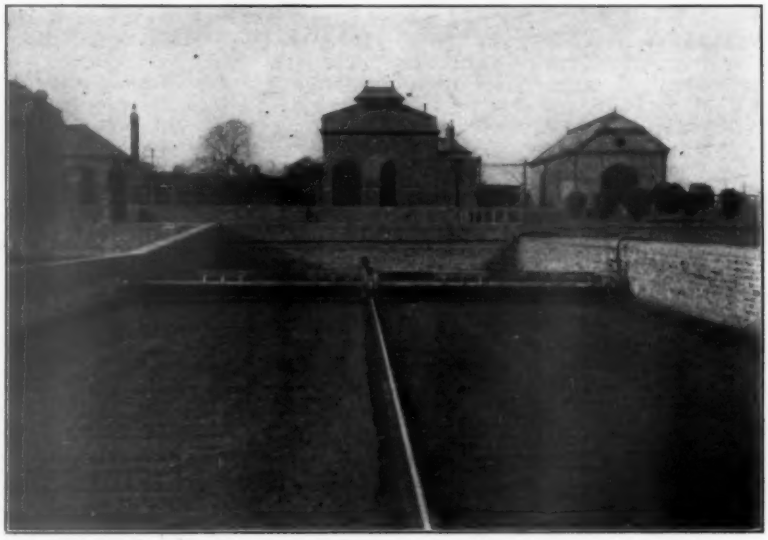
The position of the American sanitarian in regard to European sewerage matters, is expressed by the ancient metaphor of the youth on the shoulders of the giant. Observing their experiments we should see further and make less mistakes than English engineers have made. But, as I have said before, America has many problems of her own to work out.

The development of new processes through experimentation and the operation of plants, strongly points to the wisdom of erecting an experimental station in each city where the project in hand is likely to involve the city in a substantial amount. The sewage of each city is different in character from that of any other city, and money invested in experimenting will usually be saved many times over in the more individual application of the particular design thus evolved to

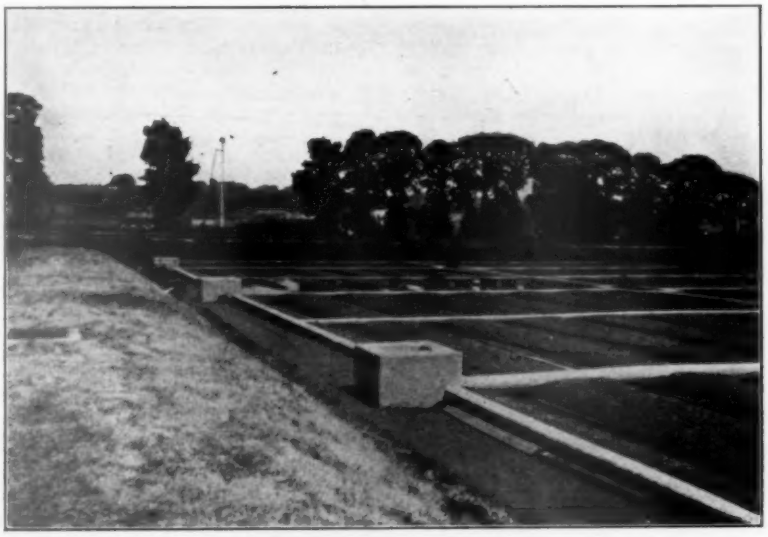


Weand's Sewage Segregator for Rough Screening of Sewage, used at Reading, Pa.

SEWAGE DISPOSAL PLANTS IN AMERICA.



Percolating Filter at Wednesbury, showing Traveling Distributer on Rail.



Dorchester, England. Storm Water Filters.

ENGLISH SEWAGE FILTRATION PLANTS.

the exact needs of that particular city. At the same time, these experiments might open the way for the discovery of some simple process which might save the city still greater sums. The investigation should include a careful study of the existing sewage, of the stream into which it flows, and the extent and intensity of the sewage therein. This investigation will have a direct bearing upon the thoroughness of the purification process which should ultimately be adopted.

A city thus engaged in local investigation under the advice of a competent engineer or commission of engineers cannot be said to be standing still. The city of Manchester made the great mistake of becoming committed to the contact bed system without sufficient experimentation, and you have been informed of the failure of her elaborate but unsuitable and unsuccessful system — a system good in itself but not fitted to meet her needs. Her experiments were not carried far enough or this mistake might have been avoided.

The benefits to be derived from such an experimental plant are not confined to the probable cheapened cost of sewage disposal plant only, but the information thus obtained may enable a city to demonstrate beyond the peradventure of a doubt that the redesigning and reconstruction or remodelling of her system is not necessary. Some cities are being compelled to do this. Without this experimentation the city might not be able to prove that it is unnecessary. I am fully convinced that in the vast majority of cases the arbitrary demands of those in authority are due, not to any desire to be arbitrary, but to their desire to give safe sanitary advice, much of which would be modified if fuller and more exact data were placed before them.

PLANT AND PROCESS OF STERILIZATION OF BOONTON RESERVOIR WATER, JERSEY CITY WATER SUPPLY.*

By George W. Fuller, Consulting Engineer, New York City.

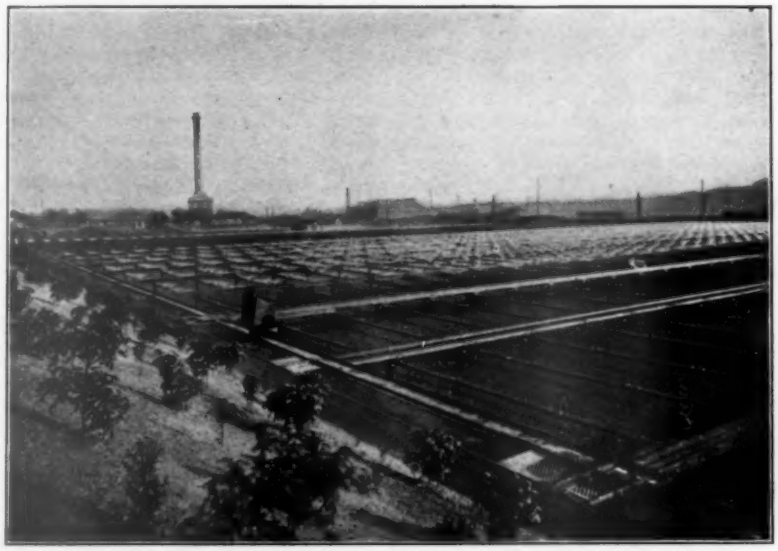
THE purpose of this paper is to outline the more important technical details of the process adopted at the Boonton reservoir of the Jersey City Water Supply Company, to destroy objectionable bacteria under the conditions stated by Dr. Leal; and also to describe the plant designed by Hering & Fuller for this sterilixing process.

This process is essentially one of exidation by which the objectionable bacteria in the water under treatment are destroyed. It is also spoken of as a "sterilization process," a name which is quite appropriate from a practical viewpoint, although not absolutely correct theorectically speaking. As a matter of convenience the plant designed for the Jersey City Water Supply Company, to be used at the Boonton reservoir for the purpose above stated, is generally spoken of as a "sterilization plant."

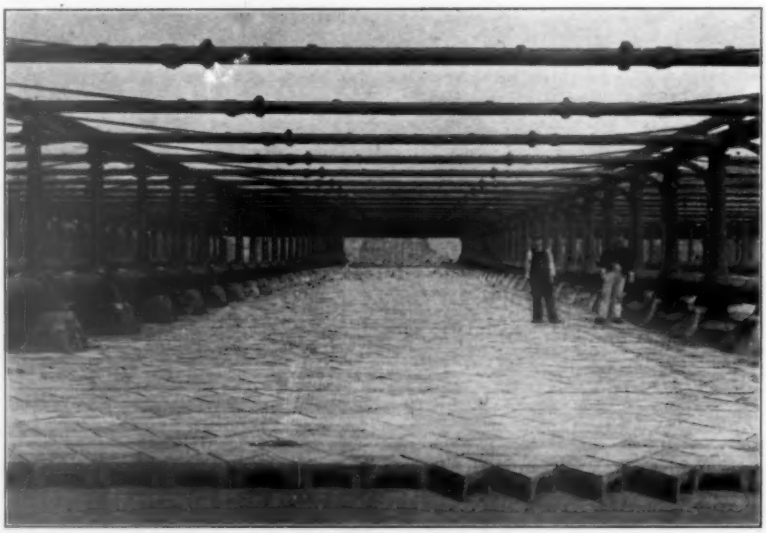
For the purpose of securing the oxidation and sterilization above mentioned the Boonton reservoir water is treated with a minute dose of bleaching powder of a high degree of purity. This compound, commonly spoken of as hypochlorite of lime, is in reality a mixed salt of calcium containing about equivalent proportions of chloride of calcium and hypochlorite of calcium. This compound is acted upon by the moisture in the atmosphere and hence is transported for the trade in tight metal drums to preserve its initial strength so far as practicable. Ordinarily this compound contains some 35 per cent of available chlorine and some 40 to 44 per cent of lime. The remainder is made up of water, part of which is combined with the chemical and part of it is uncombined water in the form of moisture, together with several impurites comng for the most part from the slaked lme used in preparing this salt.

When this applied chemical is dissolved in the water it no longer exists as a mixed salt of calcium, but appears in the form of two salts of calcium, namely, calcium chloride and calcium hypochlorite. The former of these salts remains inert and ineffective as applied to natural waters, and it is the second salt (hypachlorite of calcium) which alone serves as an oxidation and sterilization agent.

*A paper before the American Water Works Association.



Sprinkling Filters at Salford. This is one of the first examples of the Sprinkling Filter. The success at Salford and other English cities is responsible for their adoption in this country.



Sprinkling Filters at Salford. Stone filling removed—piping and tilir g clearly shown.

ENGLISH SEWAGE FILTRATION PLANTS.

When the active portion of the applied chemical, that is, the hypochlorite of calcium, is added to any ordinary natural water such as that in the Boonton reservoir, the free carbonic acid or half-bound carbonic acid in the water combines with it and there is formed calcium carbonate, and at the same time free oxychloride, known technically as hypochlorous acid, is released in the water. This latter compound is spoken of by chemists as an acid, but it is an extremely inert acid, as is shown by the fact that in the atmosphere the applied chemical is decomposed by the very weak carbonic acid contained in the air and there is set free hypochlorous acid in the manner corresponding to that taking place in the treatment of the reservoir water, as above mentioned. This oxychloride or oxy-acid is so unstable that in its pure state it is said to be unknown.

While oxychloride of hydrogen or hypochlorous acid is an extremely weak acid it is a fact well known to chemists that it is a powerful oxidizing agent. It effects oxidation in the presence of oxidizable substances by virtue of the liberation of nascent oxygen in consequence of its instability as a chemical compound. At this point it may be mentioned that this treatment is in no sense a chlorine treatment such as is sometimes spoken of and largely because of the use of the same commercial product in bleaching operations. In bleaching the commercial product is treated with strong acids which do break up the chemical and release free chlorine. Even free chlorine is not of itself an oxidizing agent, but in the presence of water it combines with hydrogen and thus sets free oxygen in an atomic or nascent state.

The weak carbonic acid, the only free acid in the Boonton reservoir water, or other natural water, is entirely incapable of releasing the free chlorine; but instead there is produced hypochlorous acid, as above stated, and it is this weak and unstable oxy-acid or oxychloride which gives up its oxygen to form a powerful oxidizing agent. Hypochlorous acid is not a poison. The chlorine of this compound combines with the alkalinity of the water, forming calcium chloride.

The Boonton reservoir water is ordinarily well supplied with atmospheric oxygen and in fact during the colder portions of the year is doubtless saturated with atmospheric oxygen. It is to be pointed out here that the oxygen resulting from the application of chemical in this process is not ordinary atmospheric oxygen. On the contrary it is in the most active state and in what chemists speak of as a "nascent state" or "atomic state." In this form at the instant of its liberation from the applied chemical it is by no means the inert agent of ordinary atmospheric oxygen, but in a far more active stage and capable of oxidizing substances which are quite unaffected by the oxygen of the atmosphere as ordinarily present, either in the atmosphere or in natural waters.

The expression "potential oxygen" has been used on this work to indicate the strength or quantity of oxygen which could be produced from the applied chemical. It is a much more rational expression than the "available chlorine" of the industrial chemists because as applied to water no chlorine as such becomes available.

The word "ozone" means a modified form of oxygen capable of far more intense oxidation than the ordinary atmospheric oxygen. It is produced by nature under certain atmospheric conditions and by certain processes in the laboratory, and in recent years its production on a large scale through the aid of electricity has constituted one of the most interesting lines of investigation as regards water purification. Difficulty in securing its uniform production in a reliable manner has been and still is a serious drawback to its use as an oxidizing and sterilizing agent in the field of water purification. For that reason another process was recommended in this case for securing the same working agent by other and cheaper means and in such a manner as to put the control of the treatment within the reach of the operators of the plant at all times.

The principal substances or compounds in the water of the Boonton reservoir which are capable of oxidation under favorable conditions are those substances generally spoken of as organic matter. Some of this organic matter is dead, disintegrating and partially dissolved, and some of it is living organic matter comprising the bodies of various small micro-organisms, notably bacteria and certain forms of algae, diatoms and the like. There are also some mineral substances or compounds in the reservoir water which are not in an oxidized form, but which can be oxidized under certain conditions. They are present in very minute traces, such, for instance, as nitrogen in the form of nitrites. Another compound which is capable of passing to a more highly oxidized form is that of nitrogen in

the form of free ammonia, as spoken of by the analyst, and which exists in water, for the most part, in the form of ammonium carbonate.

While it is true that the substances last mentioned are present in very minute quantities in the reservoir water, it is also true that the dose of applied chemical in this process is also very minute as regards the quantity of "potential oxygen" which it possesses. By potential oxygen is here meant the content of the applied chemical as to the amount of oxygen which it can yield under conditions of complete decomposition under conditions obtained with a natural water such as that in the Boonton reservoir.

In speaking of the oxidizability of certain constituents of the reservoir water on the one hand, and of the potential oxygen applied in the course of the treatment on the other hand, it is to be clearly borne in mind that the quantities are very minute, dealing with fractions of one part of the substance in question in one million parts of water; or, stating it in another form, they are present as very small fractions of one grain to a gallon of water. The significance of these dilutions has a substantial bearing upon the understanding of the practicability and merit of the process in question.

It is ordinarily said that dead organic matter is present in water either in a dissolved or suspended form. Where particles of disintegrated leaves or twigs are present, and of a size to be visible as suspended matter when viewed by the naked eye, there is no opportunity for mistaking what is meant by that class of suspended organic matter. This class, of course, is more or less present in mixtures with mineral substances resulting from the soil washings of the water shed during rain storms.

As regards organic matter in solution, that is an expression which is not plainly understood by most people. In fact, it is a difficult one to state with precision from the viewpoint of the modern theoretical chemist. For the purposes at hand, however, it may be said that a large proportion of the so-called dissolved organic matter which gives, for instance, the so-called color or vegetable stain to the Boonton water, is not truly in solution in the full chemical sense, but as a matter of fact is in a colloidal state. This colloidal state is an intermediate one between the true solution and the suspension state. It really means that the colloidal particles are in an exceedingly fine state of subdivision and are truly in suspension and not in solution. This is indicated by the inability of large portions of this vegetable stain or color to pass through a dialyzer or parchment, and which is a test of the conditions of substances as to whether they are in a true solution or in a semi-soluble or colloidal state. In the reservoir water organic matter is present in the dissolved, colloidal and suspended forms.

This rough description of organic matters in the reservoir water, such as result for instance from the decomposition of leaves, is of importance in showing the relative amounts of oxidizability of the constituents of the water, because dissolved organic matters, generally speaking, consume potential oxygen more readily than colloidal or suspended organic matter, other things being equal.

Taking the bacteria as the form of living organic matter of most significance in this problem, it may be stated that bacteria from the standpoint of readiness of oxidation, may be divided into several classes. The first of these, in which presumably the majority of bacteria are ordinarily present in waters, is the normal or vegetative state in which the cells are found with the tiny bits of protoplasm surrounded by a membrance. As is well known it is in this form that the bacteria are most readily destroyed by oxidation and other forms of sterilization.

A form in which bacteria sometimes occurs and in which it is very difficult to destroy them by oxidation and other means of sterilization, is that known as the "spore" form. When in this condition the normal bacteria cell has practically given place to a small kernel or substance much smaller than the normal cell and within which kernel the protoplasm or essence of life is contained in a thick membrance or sheath, much thicker than the membrance of the ordinary vegetable bacteria. Indeed this membrance is sufficent to protect it from destruction under a great variety of conditions. In practical sterilization it is found that even boiling temperatures of water destroy some of these "spore" forms of bacteria with great difficulty.

Fortunately in the problem at hand the importance of this bacteria condition is comparatively slight and almost negligible for the reason that the specific germs of intestinal diseases, such as typhoid fever, Asiatic cholera, etc., do not form spores and the same is true of B. coli and the majority of the bacteria which domi-

nate the intestinal tract of man and domestic animals.

To obtain a clearer conception of the conditions which actually obtain in a natural water such as that of the Boonton reservoir, especially from the standpoint of destroying all bacteria, it is also to be pointed out that the vegetative bacteria, or the normal bacteria cells, may to a slight extent be present in water in the interior of tiny masses of suspended matter, the surfaces of which particles may become sterilized without necessarily having the active oxidizing and sterilizing agent penetrate fully within such suspended particles.

Bacteria in spore form or contained within particles of suspended matter are not killed entirely in this process. In making the above statements, it is not to be inferred that the recommended process suffers in efficiency as to destruction of objectionable vegetative bacteria. On the contrary it confirms the reliability of its normal action and furthermore explains the few residual bacteria which are in the water treated by the process just as they are in the effluents of filters.

This plant was built at the large impounding reservoir on the Rockaway River, a tributary of the Passaic, at Boonton, N. J., about 25 miles west of New York City. It is located below the main Boonton dam immediately adjoining the so-called lower gate house, the western end of which is about 30 ft. east of the down-stream face of the dam, measured at ground level. This gate house is located towards the southern end of the dam, the spillway of which is at the northern end. From the upper gate house, built within the dam, to this lower gate house in question there are four 48-in. steel pipe lines conveying water in desired quantities to the gate house which is located at the head of the concrete aqueduct leading towards Jersey City.

The elevation of the spillway of the dam is approximately 305 and the center line of these 48-in. pipes is at elevation 257.25.

The sterilization and oxidation plant was designed to permit the commercial product known as "high grade bleaching powder" or hypochlorite of lime to be dissolved in a convenient manner in tanks located adjoining the lower gate house, whence the solution is pumped with suitable devices into grids of perforated pipe placed in the mouth of the several 48-in. pipe lines conveying water from the reservoir to the head of the Jersey City aqueduct.

Before taking up the individual details of the works as built, it will be convenient to state in outline the different parts of which the plant consists, as follows:

(a) A store-room with a floor area of about 20 by 33 ft.; a main operating room about 30 by 33 ft.; an engine room about 8 by 16 ft.; and a boiler room about 10 by 33 ft.

(b) Three dissolving tanks, each 6 ft. in diameter and about 3 ft. deep and placed within the respective solution or mixing tanks, all of which are built of concrete.

(c) Three solution tanks, each of a capacity of 1400 cu. ft.

(d) Water supply, comprising two 3-in. pipe lines connecting with the 48-in. lines coming from the reservoir, with water under a static pressure of about 15 lb.

(e) Stirring devices, consisting of revolving rakes in the dissolving tanks for getting the chemical into solution and also in the solution tanks for keeping the solution mixed so as to be of a uniform strength.

(f) Depth recorders by which a continuous automatic record is secured of the level of the liquid in each of the solution tanks.

(g) Pumping devices, consisting of two belt-driven 2-in. turbine pumps for delivering the chemical solution from the solution tanks to the orifice tanks.

(h) Power equipment, comprising two small boilers and two small engines for driving the shafting to which are belted the pumps and stirring devices, and which temporary steam plant was later replaced by water wheels driven by the water going to Jersey City.

(i) Two orifice tanks into which the chemical solution is pumped so as to maintain a fixed depth or head of solution above an orifice, the opening of which is to be adjusted to give the required volume of solution to give the prescribed dose.

(j) An alarm system by which a gong is rung with the aid of floats in the orifice tanks to call the immediate attention of the operators to any lowering of the solution level in the orifice tanks and thus guard against an underdose of solution .

(k) A set of perforated pipes or grids placed in the mouth of each of the 48-in. pipe lines coming from the reservoir to the lower gate house and through which grids the chemical solution is to be applied to each of the main pipe lines in service.

(l) A general system of pipes and drains for getting the water to the dis-

solving and solution tanks, connections from these various tanks through the pumps to the orifice tanks, and from the orifice tanks to the point of application through the grids just mentioned.

(m) A small laboratory is provided whereby the operators may make suitable tests to regulate properly the prescribed dose of chemical.

(n) Miscellaneous appurtenances, such as arrangements for heating, lighting, etc.

All of the additional works built outside of the gate house, including the various tanks, pipes, pumps, etc., are included within and beneath a one-story wooden building approximately 33 by 67 ft. in size. This superstructure covers a concrete floor built around and above the various main tanks between which is a pipe gallery. The floor of the boiler, engine and store rooms rest upon an earth fill.

The store room has a capacity of three carloads of bleaching powder, corresponding to 120 drums, or approximately 90,000 pounds. This quantity is more than ample to tide over any interruptions in the delivery of this product, as it would provide for over a year's continuous operation with the present volume of water (40 million gallons daily), according to the present dose applied.

The dissolving tanks, 6 ft. in diameter and 3.5 ft. in gross depth, are built of reinforced concrete with their tops forming a portion of the floor of the main operating room of the building housing this plant. They are located within the respective solution tanks. Over a portion of the top of the dissolving tanks is a grating made of 2-in. by ⅜-in. steel bars, spaced on 3-in. centers, through which the dry chemical is dumped.

A 2-in. supply pipe enters the dissolving tanks near the flow line which is 2.5 ft. above the bottom. The center of the 6-in. overflow pipe taking the bleach and water into the solution tank is 18-in. above the bottom. At the botton is a 4-in. blow-off pipe by which sludge or accumulated solid matter may be removed from these tanks after the soluble matters have been extracted so far as practicable.

These are the large tanks into which the solution of chemical is discharged from the dissolving tanks, for purposes of more complete solution as well as complete and uniform mixing with the aid of stirrers. These tanks, of which there are three, are each 11 ft. 3 in. deep, 11 ft. wide at the bottom and 12 ft. 4 in. wide at the top.

They are covered with a concrete deck which serves as a floor of a part of the main room, and in this floor over each tank is a manhole.

The bottom of these tanks slope to a sump and a 4-in. blow-off pipe from the lowest point provides drainage into a 32-in. steel overflow pipe extending from the adjoining gate house to the stream bed of the Rockaway River below.

A 2-in. suction pipe leads from just above the bottom of these tanks to the turbine solution pumps.

Belt-driven rakes with suitable teeth attached thereto revolve in the dissolution tanks and revolving paddles similarly operated in the solution tanks facilitate solution of the chemical and the maintaining of solution of uniform strength.

Wooden covers protect the floor stands for these devices from dust so far as practicable.

In each of the three solution tanks are float pipes, in which copper floats are placed to actuate a self-recording depth recorder of the standard type made by the Builders' Iron Foundry, at Providence, R. I. The dials are 12 inches in diameter, which is the size of the chart upon which is recorded continuously the depth of solution in tanks. Glass sight tubes are also attached to the sides of the solution tanks, so that by entering the pipe gallery the level of the solution in each tank may be noted by the level in the glass tube.

The belt-driven turbine pumps have 2-inch connections and have a nominal capacity of 25 gallons per minute. They are built of special bronze. One pump is to be used at a time, the other being in reserve.

Water coming from the reservoir to the lower gate house on its way to Jersey City drives a 30-h.p. horizontal turbine wheel to develop power needed for pumping and stirring the solutions. Temporarily two vertical boilers of 12 and 15-h.p. and two small engines of 10 and 12-h.p. were used.

There are two concrete orifice tanks, 3 feet 6 inches square in plan, and 2 feet 6 inches deep. The delivery pipe from the pump discharges into either one of these orifice tanks as desired. An excess of solution is always pumped to them, which excess flows back to the solution tank through a 3-inch overflow pipe.

Each tank is provided with an outlet in the shape of an adjustable orifice, which is made of a special composition of copper, lead and tin, and is arranged so that with the aid of a fine microm-

eter screw a cover is moved backwards and forwards over a slot, thus permitting the use of an area of orifice found to give the desired volume of solution under a constant head. As already explained, the excess volume of solution is taken care of by means of an overflow pipe, thus preventing an excessive head upon the orifice; and any deficiencies in head or depth of liquid over the orifice are indicated almost instantly by a copper float adjusted so as to ring an alarm gong.

Only one device is used at a time, so that, as in all other features, the plant is built in duplicate.

The prescribed volume of solution of known strength flows by gravity from the orifice tanks through a 3-inch galvanized iron pipe line into the screen chamber located beneath the floor of the lower gate house. This main pipe branches into four lines, each 1.5 inches in diameter and extending to a grid fastened over the mouth of each of the four 48-inch mains coming from the reservoir. The grids are made up of 1-inch pipe drilled with twelve ¼-inch openings pointed downward. The grids are fastened in place by ¾-inch wrought iron bars bolted to the masonry.

The solution and the water treated are well mixed before entering the concrete aqueduct.

WATER SOFTENING OR PURIFICATION AND ITS SAVING.*

By M. Miller.

WATER obtained for boiler use is usually impure, containing incrusting and non-incrusting solids. The continued use of impure or hard water in boilers reduces the life of the flues and fire-boxes, increases the cost of maintenance, cost of coal consumption, and in general reduces the efficiency of boilers.

With the tendency to and demand for high pressure of steam, the question of water for boiler use is becoming more serious as the streams or available water supplies continue to get harder owing to water sheds being more thickly settled and a larger per cent. of them being used for agricultural purposes. In former years the water sheds remaining undisturbed for years, the rainfall dissolved and carried into the streams the soluble matter, so, with the protection afforded by the natural sod, the per cent. of hardness carried into the streams was small compared to the large amount now carried off the fresh soil after each working.

Mountain streams often contain so little scale-forming matter that the excessive amounts of dissolved oxygen or carbonic acid which they carry in solution may cause corrosion. Such instances are familiar to railroad companies operating in the Allegheny mountains in Pennsylvania.

Peaty waters are found which contain corrosive vegetable acids. Such waters containing free sulphuric acid, and acid iron salts occur in all coal-producing districts, especially in those places where coal is washed preparatory to coke production.

Well waters containing magnesium chloride are corrosive unless they contain an excess of calcium carbonate; the same is also true of waters containing sodium chloride.

The more or less complete removal of scale-forming matter or the neutralization of corrosive substances which occur in boiler feed-water has been carried out by several methods in the United States.

These methods may be classified as follows:

1. MECHANICAL METHODS.

These include feed-water heaters, scum-catchers and blow-off cocks.

2. CHEMICAL METHODS.

(*a*) Direct Method: The chemicals are placed in the boiler or run into it with the water supply.

(*b*) Indirect Method: The chemicals are fed into the water on its way to a storage tank, which serves also for the completion of chemical reaction and for sedimentation.

(*c*) Intermittent Method: The chemical treatment is given alternately to the contents of two or more tanks, allowing enough time for the reaction and sedimentation to take place during periods of quiet. The clarified water is drawn off and pumped to storage tanks or to the places where it is used.

(*d*) Continuous Method: The chem-

*A paper before the American Water Works Association.

ical treatment is given automatically to the water as it enters the apparatus. The chemical reaction, sedimentation and clarification take place during the progress of the water through the apparatus.

CLASS 1. MECHANICAL METHODS.

Feed-water heaters remove more or less completely from water the carbonate of lime which it contains, but other and more important scale-forming substances are not affected and pass on into the boiler, from which it it is impossible to remove them. Sulphate of lime, which forms a very hard scale, is not precipitated in the form of scale until a temperature of 302° F. is obtained, corresponding to about 60 pounds steam pressure, which heat is not obtained in a feed-water heater.

CLASS 2. CHEMICAL METHODS.

2a. Direct Method.

This practice has been and is very general in the United States, and beneficial results obtained have been in exact relation to the judgment shown in selecting the chemicals and the care shown in carrying out the details of the treatment.

The purifying agents used directly in boilers include:

1. Soda ash.
2. Caustic soda.
3. Phosphate of soda (tri-sodium phosphate).
4. Tannin compounds.
5. Fluoride of soda.
6. Aluminate of soda.

Soda ash has been most widely employed. Used without discrimination, it is rarely beneficial; combined with regular blowing off of the sludge produced by chemical action, it is a measure of great economic importance.

The Soda-Ash System.

Principle: "When waters are treated in the boiler with soda ash, the incrusting solids are changed to carbonates and precipitated as a soft sludge, which is readily blown out, instead of coming down in a crystalline condition and adhering to the boiler."

For Each Grain per Gallon.	Soda Ash per 1,000 Gallons.
Calcium carbonate	0.02
Magnesium carbonate	0.02
Calcium sulphate	0.10
Magnesium sulphate	0.13
Magnesium chloride	0.16

Sludge Removal. By means of blow-off cocks drawing from several parts of the boiler, sufficient sludge and alkali are removed so that the boiler can be continued in service a much longer time than would be possible otherwise. Some blowing off must be done when boiler is at work, but the greatest efficiency in sludge removal is secured if time for settling is allowed. About 4 per cent. of water is blown out with the sludge.

Even in the worst district, the life and mileage of flues and fire-boxes were more than doubled.

Treatment. Waters containing 25 grains of incrusting solids per gallon required not over 4 pounds of soda ash per 1,000 gallons of water used.

The cost of heating the 4 per cent. of water which was blown off was estimated at from 0.4 to 0.8 cent per 1,000 gallons.

Thus the total expense for chemicals and for loss of heat due to blowing off would not exceed 4.8 cents per 1,000 gallons.

Advantages of Direct Soda-Ash Treatment. Elimination of first cost and interest charges on softening machines or plants.

Limitations of Direct Soda-Ash Treatment. Boilers must be more frequently washed out, because blowing off does not completely remove sludge.

Foaming occurs frequently, due partly to suspended sludge and partly to the presence of carbonate of soda in variable excess in the water.

Very hard water cannot be treated sufficiently to prevent scale formation without introducing soda ash enough to cause foaming.

Conclusion. While the use of soda ash is a very useful temporary expedient directed toward scale prevention, all large steam users will eventually discard it in favor of methods which purify feed-water before it reaches the boiler.

2b. Indirect Method.

Treatment of water by the introduction of chemicals into the water as it flows to the storage tank was the first step in the evolution from direct treatment toward complete softening machines. It was designed to avoid the first cost of softening machines by utilizing the existing storage tank for chemical reaction and sedimentation.

Several such plants exist in the United States, and many have existed.

They have no feature to recommend them except low first cost.

2c. Intermittent Method.

The devices described under this heading are intermittent in operation, in that there is a pause of several hours after treatment. This is to give the time considered necessary for chemical reaction and sedimentation.

The general plan of operation is as follows:

Two or more tanks are provided, the aggregate capacity of which is usually four times the hourly output expected.

These may be of either wood or iron construction, and may be placed on ground level or elevated on trestle-work, according to whether repumping of softened water is to be allowed for or avoided.

The tanks are filled alternately to a certain level with hard water. In some plants the milk of lime is added during the filling, and the agitator is run at the same time. In most of the plants the practice of dissolving the soda ash in the milk of lime and adding both together when the tank is filled is the one followed.

Agitation continues for 15 to 20 minutes, followed by a period of perfect rest, usually varying from one to two hours.

At the end of this time the softened water is drawn off in a proper manner to avoid the introduction of the precipitated solids to storage tanks from which it is repumped to a higher elevation if necessary, or drawn direct from the treating tank.

2d. Continuous Method.

The type of machine now referred to is the one which is so designed that the flow of water to the plant operates all necessary mechanism (stirrers, etc.).

The feed of chemicals is regulated by proportioning devices. Proper mixing of chemicals with hard water takes place automatically as the water passes through the machine; the chemical reaction is complete and sedimentation takes place. A filter at the top of the machine gives final clarification, and the softened water is discharged without repumping into the storage tank.

Great advancement has been made in results obtained by use of this method and the simplicity of the machine used.

THE ECONOMIC RESULTS OF WATER SOFTENING.

The considerations which lead to the taking up of water softening by steam users may be grouped as follows:

First. Loss of service of boilers, due to impossibility of satisfactory continuous operation with hard water.

Second. Possibility of substantial savings in fuel and repair bills and the checking of rapid deterioration of boilers.

The direct cost of water for boiler use is often but a small part of the expense in connection therewith.

The direct cost involves:

1. Cost of supply and pumping plant.
2. Cost of pumping.

The indirect cost involves expense due to:

1. Corrosion of boiler-tubes and fire-box by waters containing acids.
2. Incrusting due to presence of scale-forming material.
3. Interference with operation and incidental danger due to engine failures from these causes and from boilers foaming.

The cost of water softening undertaken for the first reason is not always a matter of prime importance. It must be reasonable, of course, but results are the main thing. In most cases, however, water softening stands or falls by the relation of what it costs to what it accomplishes.

The charges against a water-softening installation are:

Interest on cost of plant.
Depreciation.
Chemicals for softening.
Attendance.
Power for operation (and repumping).

The credit items for a softener are:

Fuel saving.
Repair saving.
Depreciation saving.
Increased service obtainable from steam generators.

Cost of Softening Plants.

The best softening plants cost from $4 to $5 per h. p. for installation up to 1,000 h. p.; for 1,000 to 2,000 h. p. the cost is $4 to $3 per h. p. From 2,000 to 5,000 h. p. the cost is $3 to $2 per h. p. From 5,000 to 15,000 h. p. the cost is $2 to $1.20 per h. p.

Depreciation.

The above figures refer to steel construction. Plants for which wooden tanks are used are sometimes offered at as high rates, but the depreciation of wooden tanks under service conditions is much greater, besides other disadvantages. If steel tanks are reasonably well cared for, 5 per cent. is more than enough to allow for their depreciation.

Cost of Chemicals.

The quantity of chemicals required for softening varies directly with the character of the water treated. The prices of lime and soda ash do not vary greatly in different sections of the country. There is, however, great choice in commercial lime, much of the building lime being so high in magnesia as to make it unfit or uneconomical to use. From 90 to 95 per cent. lime can be had and should be insisted upon.

In my experience I have found it more economical to use hydrated lime,

thus avoiding the objectionable features associated with lump lime, which are the grit and unburned limestone and the loss due to air slacking of the lime while in transit and while stored at the plant.

The cheapest waters to soften are those the hardness of which is due to carbonates of lime and magnesia only. Such waters require simply lime-water treatment. It costs only 0.2 cent per 1,000 gal. to remove 1.42 lb. of carbonate of lime (equivalent to 10 gr. per gal.), and only 0.48 cent to remove the same quantity of carbonate of magnesia.

The amounts are sufficient to give a great deal of trouble in heaters and boilers

The removal of sulphates and other soluble compounds of lime and manesia from water requires the use of soda ash. It costs 1.20 cents per 1,000 gal. to remove sulphate of lime equivalent to 10 gr. per U. S. gal. The same amount of sulphate of magnesia requires 1.36 lb. of soda ash, which costs 1.36 cents per 1,000 gal.

Attendance.

The cost of attendance at softening plants varies greatly, but is never more than that of the time of one man (or boy). It is often much less. The most common arrangement is for the engineer or pumper to look after the softening plant.

With the best type of plants two or three hours per day are all that are required for attendance unless the installation is very large.

Chemical tests for control of the softening plant can be carried out by persons of average intelligence.

The most satisfactory plants are those where the power for mixing and pumping the chemicals is gotten from the flow of water to the softening plant, so arranged that the flow of the water starts all stirrers, or other mechanism, and the filter, as it becomes dirty, changes the direction of the flow of water, automatically changing the valves allowing the treated and filtered water to be drawn from the storage tank through the filter, washing the sand and discharging the sludge through sludge pipes into sewers. The tilting bucket can be so arranged as to give the desired amount of water to wash the filter when it will, by counter weights, be carried back to its normal position.

The advantage of this plant is that it is automatic, and requires less attention on the part of the operator. The plant was designed for railroad water supply, but what holds good for railroad water supply will be equal for any steam boiler.

The best plants have all stirrers or other mechanism actuated by water power. The flow of water to be softened starts everything, and the water is softened at a sufficient elevation to run by gravity to the place where it is to be used.

FUEL SAVING.

The earliest recorded researches on the subject of loss of heat caused by boiler incrustation are those of John Graham, conducted in 1850 to 1857, and published in Memoirs of the Literary and Philosophic Society of Manchester in 1860. He says: "A scale of sulphate of lime $\frac{1}{10}$ in. thick reduced the efficiency 14.7 per cent."

Dr. J. C. Rogers states that a scale $\frac{1}{15}$ in. thick makes 15 per cent. more fuel necessary than with clean heating surfaces.

Rankin states that it is estimated that $\frac{1}{10}$ in. of scale requires the use of 16 per cent. more fuel.

Reuben Wells ran two engines for several months with heating surfaces covered with scale, and an equal length of time later with clean heating surfaces, and found a fuel saving of 17.5 per cent. Details of scale thickness or density are not given.

These records would seem to be sufficiently convincing, and yet they are sometimes questioned, as if they were theoretical calculations instead of actual results.

FUEL SAVING ON RAILROADS.

Three railroads, the Union Pacific Ry., Chicago & Northwestern and the Pittsburgh & Lake Erie R. R. Co., have installed a large enough number of softening plants to warrant the expectation of definite results showing fuel economy, etc.

Of these, only the Union Pacific Ry. has given out preliminary results. They report 7½ per cent. increase in gross ton-miles per pound of coal. This is believed to represent the effect on boiler conditions of 10 softening plants on the Nebraska Division, and is really not a comparison between steam raising with clean tubes and the same with scaled ones.

Better results are sure to be obtained. Even as they are, they lend additional evidence to an already certain matter.

BOILER REPAIR SAVING.

Estimates. For C., B. & Q. Ry. Co. engines operating in Illinois and the hard-water districts of the Middle West, Wickhorst estimates that boiler repairs cost $1,200 per locomotive per year, and that softening should reduce this at least 25 per cent.

The engineering department of the P. & L. E. R. R. Co., having moderately hard waters to deal with, estimate that with water softening a saving of at least $100 per locomotive per year will be realized from boiler repair saving.

Actual Results. Returns from railroads, etc., having water softeners in operation give results which exceed the above estimates.

The C., M. & St. P. Ry. Co. reported in 1899 that Smith's soda-ash treatment of boiler water had made possible an annual saving of $75,000 in boilermakers' pay roll.

The Union Pacific Ry. Co. report as a result of water softening 34 per cent. decrease in boiler repairs per engine-mile.

The C. & N. W. Ry. Co. report 40 per cent. decrease in boilermakers' force required for repairs on their Iowa Division during the last six months of 1903 as compared with the corresponding period in 1902.

On the Missouri Division of the St. Louis, Iron Mountain & Southern Ry. Co. in 1906 three water-softening plants were installed at an actual cost of $12,500, which made an actual saving of $12,245 in boilermakers' salaries, handling an increased tonnage of 15 per cent., reducing engine failures 97 per cent. with a decrease in number of engines.

On the Colorado Division of the Missouri Pacific Ry. Co. the installation of four treating plants out of 14 water stations decreased the cost of boilermakers' salaries in one year $8,800, handling an increased business of 14 per cent. with 5 per cent. less engines.

These records show that in all cases where water contains over 10 gr. of scale-forming ingredients, by treating the water the life of flues and fire-boxes is increased 100 per cent. With 20 gr. the increased life of flues and fire-boxes with treated water is 200 per cent.

At the Missouri Pacific shops at Kansas City, Mo., we have three boilers in use, one 150 h. p., one 80 h. p. and one 45 h. p. Previous to 1905 flues had to be changed in these boilers every six months. In 1906 we put into use a water softening plant and renewed the flues in all of the boilers, and they have been in use ever since and show no signs of leaking at the present time, after three years' use of softened water.

During the month of December, 1905, we pumped 8,220,000 gallons of water; and in the month of December, 1908, 12,460,000 gallons of water, with a saving of 20 per cent. in fuel over that used in December, 1905.

About the same ratio of saving is shown on switch engines working in this yard, where they get nothing but softened water. Following is the mineral analysis of the water at this point:

	Gr.
Carbonate of lime	16.79
Carbonate of magnesia	3.42
Sulphate of lime	0.75
Sulphate of magnesia	2.06
Oxides of iron and aluminum	0.12
Silica	1.91
Alkali chlorides	0.88
Alkali sulphates	0.29
Organic matter, etc	0.82
Total solids	27.04

Total incrusting solids 25.05 grains per U. S. gal., or 3.58 lb. per 1,000 gal. Total non-incrusting solids 1.99 gr. per U. S. gal., or 0.28 lb. per 1,000 gal.

Depreciation of Boiler Plant.

It is difficult to put into dollars and cents exactly what water softening means in prolonging the life of boilers. The wear and tear on boilers using softened water would certainly average 75 per cent. less than with untreated water.

The Union Pacific Ry. Co. now finds a set of flues lasting two and one-half years, where formerly six months to a year was the limit.

Washing Out Boilers.

A marked decrease in this item is noticed by users of water-softening plants.

While the accumulation of soda salts necessitates water changing by blowing off quite frequently, yet complete washing out for the removal of sludge and scale is much less frequently required than formerly.

Increased Service from Locomotives.

When locomotives are in the roundhouse or shop, their owners are losing; the same would be true of any commercial plant where steam boilers are used.

1. Interest and depreciation.
2. Their entire earning capacity.

Instances are known in industrial plants where water softening has made so much more boiler horse-power constantly available that contemplated extensions of plants have become unnecessary.

It is already evident that the financial benefits derived from the adoption of water softening far outweigh the expense.

Chemical Control of Softening Plants.

Skilled supervision is not necessary after the operator has learned to make tests for hardness, alkalinity and excess of lime.

Hardness is determined by the soap test, alkalinity or acidity by titration, with standard acid or alkali. The silver nitrate test is used for detecting excess of lime.

By use of tables the operator is able to change the treatment to suit the conditions shown by his tests.

Prof. L. P. Breckinridge, of the University of Illinois, as a result of careful tests of the effect of scale on rate of evaporation in a locomotive boiler, showed the loss due to scale from 1/32 to 3/64 inch in thickness to be 9.55 per cent. as compared with the results from the same engine after cleaning the boiler and putting in new flues.

It is assumed that the loss is indirectly in proportion to the thickness of the scale.

Assuming 1/32 in. formation in 6 months, which would be produced by a very fair quality of water, 10 grains of incrusting solids and a loss of 9 per cent. in evaporation due to scale of this thickness, we have

Months boiler operated without cleaning.	Loss of evaporative efficiency at end of period. Per cent.	Average loss of evaporative efficiency for period. Per cent.
2	3	1.5
4	6	3.0
6	9	4.5
8	12	6.0
10	15	7.5
12	18	9.0

Loss of evaporative efficiency means increased coal consumption. Assuming the normal consumption of an engine per year as 3,000 tons at $2 per ton, equals $6,000 and 5,000,000 gallons as the normal water evaporation, gives.

Months boiler operated without cleaning.	Average loss of evaporative efficiency for period. Per ct.	Cost of increased coal consumption per engine per year.	Cost of increased coal consumption per 1000 gal. of water evaporated.
2	1.5	$ 90.00	1.8 cts.
4	3.0	180.00	3.6 cts.
6	4.5	270.00	5.4 cts.
8	6.0	360.00	7.2 cts.
10	7.5	450.00	9.0 cts.
12	9.0	540.00	10.8 cts.

The cost of washing locomotive boilers may be assumed roughly as from 60 cents to $1.20 per boiler washed, averaging say $1, and the saving due to reducing the frequency of washing from each 20 days to each six months would be about $20 per year, or 0.4 cent per 1,000 gallons of water used.

The cost of removing, cleaning and replacing boiler tubes per set can be placed at $110. The difference in life with good and with bad water may be taken roughly at 24 months for good water and 6 months for poor water used. While these figures are mostly from a railroad saving, the same would hold good in the boiler-room.

LIABILITY OF WATER COMPANIES FOR FIRE LOSSES.*

By Chester R. McFarland.

THIS is a subject which has at some time engaged the attention of the water works superintendents of at least twenty-two States, and in some of these States is still a very serious question, and particularly is this so in the State of Florida.

On the 23d day of May, 1905, there occurred in the city of Tampa a fire which burned a brick building in which there was located on the first floor, two places of business; one a saloon and the other a five and ten-cent store known as the Bee Hive. Over these two stores was located the armory of the local militia. Adjoining this building on the north was a two-story brick building in which there were located on the ground floor two places of business; one was a pawnbroker next to the burned building, and the other a hardware store, and over these stores were warerooms. The fire broke out in the Bee Hive, and was caused by an explosion of a gasoline lighting system, and was communicated from there to the saloon and the armory. The fire department failed to control the fire until after it had destroyed the first building, and damaged the goods of the pawnbroker in the adjoining building. The building

*Paper before the American Water Works Association.

in which the fire started was owned by R. Mugge, and he brought suit against the Tampa Water Works Company to recover for the loss of the building and saloon, on the ground that the Water Works Company did not furnish sufficient water to put out the fire. The company demurred to his bill of complaint, and the Circuit Court sustained the demurrer. The plaintiff took an appeal to the Supreme Court of the State, and the Supreme Court reversed the decision of the Circuit Court and remanded the case for hearing on its merits. (52 Fla. 372.) This case has never come to trial on its merits.

On March 1, 1908, a conflagration occurred in the northeast part of the city and a large district was burned and nearly one hundred suits were filed against the Water Works Company, aggregating about $1,250,000. Almost all of these suits were filed by the insurance companies who had taken subrogation from the owners; one of these cases coming up for hearing in the Circuit Court, the Water Works Company demurred, and the court sustained the demurrer. The plaintiff appealed to the Supreme Court. This case is known as the A. C. Woodbury vs. Tampa Water Works Company. When it was heard in the Supreme Court, the court sustained the Circuit Court on the ground that the plaintiff's property was not located where the fire started, and that it did not appear that the defendant was in any way responsible for the starting of the fire, or it was under a duty to extinguish the fire, or that it did not supply with water, as legally required, the hydrant at or near the plaintiff's property at the time the fire reached the property.

I am not a lawyer and have had to rely largely on the briefs submitted by the attorneys of the Tampa Water Works Company, to whom I am largely indebted for the references herein contained.

The case of Paducah Lumber Company vs. Paducah Water Company, 89 Ky. 340, was the pioneer case (decided in 1889). In this case the court held that a water works company which has made a contract with a city to supply hydrants with water is liable to an individual for negligence whereby his property is destroyed by fire, but I doubt if the court would have gone so far had there not been in existence in addition to the city contract, a contract directly between the plaintiff and defendant binding the latter to furnish water to the plaintiff's private hydrants. This seemed to be the opening wedge, and was followed by suits in various States, not only in cases where there was a private contract, but suits based on the city contract only.

It looks as if the Kentucky court itself had at one time become doubtful about the propriety of the decision in the Paducah case, for, while the latter cases in Kentucky have gone the whole length of the dictum in the Paducah case, Lexington Hydraulic & Mfg. Co. vs. Oots (Ky. 1905), 84 S. W. Rep. 774, 777; Graves County Water Co. vs. Ligon, 112 Ky. 775, 66 S. W. Rep. 725; Duncan vs. Owensboro Water Co. (Ky. 1889), 12 S. W. Rep. 557; yet in one of the more recent ones it is hinted that it would not do to upset the previous ruling, because such a course would disturb (and especially in that case) the operation of contracts entered into after the Paducah case was decided. Graves County Water Co. vs. Ligon, 66 S. W. Rep. 725, 726 Ky.

The fact that in the Paducah case there existed a direct contract between the plaintiff and defendant binding the latter to furnish water to the plaintiff's private hydrants, undoubtedly had some influence with the court as pointed out in Lovejoy vs. Bessemer Water Works Co. (1906), 146 Ala. 374, 7 Ann. Cas. 1068; Bush vs. Artesian, etc., Water Co. (1895), 4 Idaho 618, 43 Pac. Rep. 69, 95 Am. St. Rep. 161; Mott vs. Cherryvale Water & Mfg. Co. (1892), 48 Kan. 12, 16, 28 Pac. Rep. 989, 30 Am. St. Rep. 267, 15 L. R. A. 375; Eaton vs. Fairbury Water Works Co. (1893), 37 Neb. 546, 552, 56 N. W. Rep. 201, 40 Am. St. Rep. 510, 21 L. R. A. 653; Stone vs. Uniontown Water Co. (1895), 4 Pa. Dist. 431; Boston Safe Deposit & Trust Co. vs. Salem Water Co. (1899), 94 Fed. Rep. 328, per Ricks, D. J.

In other cases the reasoning in the Kentucky court has been pronounced unsatisfactory for the case having been cited by the council for the defeated plaintiff as the report shows, it was ignored in the court's opinion. Fitch vs. Seymour Water Co. (1894), 139 Ind. 214, 37 N. E. Rep. 982, 47 Am. Rep. 258; Wilkinson 78 Miss. 389, 28 So. Rep. 877; Metx vs. Water Works & Electric Co. (1906), 202 Mo. 324, 100 S. W. Rep. 651; Howsman vs. Trenton Water Co. (1893), 119 Mo. 304, 315, 24 S. W. Rep. 784, 23 L. R. A. 146, 41 Am. St. Rep. 654; Blunk Water Works Co. vs. Brownless (1895), 10 Ohio Cir. Ct. Repts. 620, 50 C. D. L.; House vs. Houston Water Works Co.

(1895), 88 Tex. 233, 31 S. W. Rep. 179, 28 L. R. A. 532, where Judge Brown noted the fact that no authority was cited in the Kentucky case; Nicol vs. Huntington Water Co. (1903), 53 W. Va. 348, 44 S. E. Rep. 290.

But the North Carolina courts followed the Kentucky courts in the case of Gorrell vs. Greensboro Water Supply Co., 124 N. Car. 328.

This case was decided in 1899, and is one of the few cases which hold that water companies are liable to an owner of property destroyed by fire in case of failure to supply water and pressure at the time of the fire. The action brought in this case was *ex contractu*, plaintiff suing as a beneficiary of the contract between the city and the company. In this case the chief justice and one of the judges of the North Carolina court dissented in the case. The decision rests chiefly upon the authority of the Paducah Lumber Co. vs. Paducah Water Co., 89 Ky. 340.

The Gorrell case has been followed in Fisher vs. Greensboro Water Supply Co., 128 N. Car. 375, 38 S. E. Rep. 912, where plaintiff recovered in an action of tort; Jones vs. Durham Water Co., 135 N. Car. 553, 47 S. E. Rep. 615, 138 N. Car. 383, 50 S. E. Rep. 383, where it seems the action was *ex contractu*..

The conclusion in the Gorrell case was pronounced unsound in Ukiah vs. Ukiah Water & Imp. Co. (1904), 142 Cal. 173, 179, 75 Pac. Rep. 733, 100 Am. St. Rep. 107, 64 L. A. R. 231; Nichol vs. Huntington Water Co. (1903), 53 W. Va. 348, 44 S. E. Rep. 290; Lovejoy vs. Bessemer Water Works Co. (1906), 146 Ala. 374, 9 Ann. Cas. 1068, where the decision in the Gorrell case was rested upon the principle, stated by the court in general terms, that one not a party or privy to a contract, but who is the beneficiary thereof, is entitled to maintain an action for its breach, and many cases are cited which are assumed to sustain the general proposition, which was stated without qualification. It is not true, however, that the principle can be maintained to the full extent and in the unqualified terms stated by the Supreme Court of North Carolina.

This decision was followed by the Florida Supreme Court in the case of Mugge vs. Tampa Water Works Co., 52 Fla. 371.

After quoting extensively from Judge Clark's opinion in Gorrell vs. Greensboro Water Supply Co., 124 N. Car. 328, and from Mr. Justice Brewer's opinion in Guardian Trust & Deposit Co. vs. Fisher, 200 U. S. 57, the court says:

"It seems to us that the views expressed by Justice Brewer and Justice Clark of North Carolina are the most logical and reasonable and most nearly satisfy the sense of justice and right."

It appears that the decision is based upon the ground that the defendant assumed a "public duty of furnishing water for extinguishing fires according to the terms of its contract," and for negligence in discharge of that duty is liable in an action of tort. (52 Fla. at p. 388.)

The court also quotes with approval from the opinion of Judge Thompson in Lampert vs. Laclede Gas Light Co., 14 Mo. App. 376.

But it appears that Judge Thompson's views have not found favor with the Supreme Court of Missouri. See Metz vs. Water Works & Electric Light Co. (1906), 202 Mo. 324, 100 S. W. Rep. 651; Howsman vs. Trenton Water Co. (1893), 119 Mo. 304, 309, 24 S. W. Rep. 784, 23 L. R. A. 146, 41 Am. St. Rep. 654.

The three States heretofore mentioned, that is, Kentucky, North Carolina and Florida, seem to be the only ones that have gone so far as to hold water companies liable to individuals and taxpayers under a contract made with the city for the purpose of furnishing water for fire protection.

As a matter of public policy it would seem that these courts have erred. Corporations organized for the purpose of supplying water to cities and towns must necessarily perform the service at a reasonable rate, and if water companies are to become insurers of property the rate of returns must be such that no community would tolerate them for a moment, and even if the city would consent to such a remuneration for hydrant rental as to enable the water company, under ordinary circumstances, to protect itself against losses, yet, a conflagration might at any time occur of such magnitude as to bankrupt the company, and thereby disable it so far that it would be unable to protect the very citizens who had been taxed for such an emergency.

If water companies were to be held liable for fire losses, then they must necessarily provide a large reserve fund from year to year to meet any and all emergencies; in other words they become insurers against loss due to any lack of pressure or supply in case of fire. The water company would be placed in a rather peculiar position.

The water is to be furnished to the fire department of the city, and they are to apply the water, not the water works company, and who can say that the water was not supplied in proper quantity and with proper pressure and that the failure to put out the fire was not due to some neglect or failure on the part of the fire companies. This being the case, the services rendered must necessarily be burdened with much unreasonable expense due to a multitude of suits, many of which would have no real and just claim. If the building was destroyed and it was a well-established fact that the water company was liable either by lack of supply or pressure, it would be most natural for the fire company to say that the fault was the water company's, otherwise the fire would have been put out; and if the fire companies were allowed to use this as a shield, it would result in the destruction of the efficiency of the companies. Nothing that I can say so clearly expresses the full meaning of the liability of the water company as the language of Judge Provosty of the Supreme Court of Louisiana in the case of Allen & Curry Mfg. Co. vs. Shreveport Water Works Co. (1905), 113 La. 1091, 1109, 37 So. Rep. 980, 2 Ann. Cas. 471.

"Perhaps if the city found a contractor so benevolent or simple as to be willing to assume such a liability without exacting additional pay for so doing, it might be our duty to take advantage of the situation and impose such a liability; but where would we find a contractor of that type? It goes without saying that no contractor would expose himself to a lawsuit in the wake of every fire, without exacting pay for so doing, and the pay would have to be very heavy, for the experience of every day teaches that negligence of employes cannot be entirely guarded against, and at any moment, under such a liability, heavy damages might have to be paid; in fact, a general conflagration resulting from negligence of an employe might utterly bankrupt the contractor. It is entirely improbable that the city of Shreveport would have been willing to impose so heavy a burden upon her treasury."

This was the language of a court reversing itself in the case of Planters' Oil Mill vs. Monroe Water Works and Light Co. (1900), 52 La. Ann. 1243, 27 So. Rep. 684, wherein the court had held a water company liable, having considered the jurisdictions which have held adversely to the water companies, to wit: *Kentucky*—Paducah Lumber Co. vs. Paducah Water Co., 89 Ky. 340 (1889). *North Carolina*—Gorrell vs. Greensboro Water Co., 124 N. Car. 328 (1899). *Florida*—Mugge vs. Tampa Water Works Co., 52 Fla. 371 (1906).

The striking feature is that in twenty other jurisdictions the court has held for the defendant as a matter of law. These jurisdictions include the following: *Connecticut*—Nickerson vs. Bridgeport Hydraulic Co., 46 Conn. 24 (1878), opinion by Park, C. J. *Tennessee*—Foster vs. Lookout Water Co., 3 L. R. A. 42, Tenn. (1879), opinion by Cooper, J. *Nevada*—Ferris vs. Carson Water Co., 16 Nev. 44 (1881), opinion by Belknap, J. *Pennsylvania*—Beck vs. Kittaning Water Co., 11 Atl. 300 (1887); Stone vs. Uniontown Water Co., 4 Pa. Dist. Repts. 431 (1895); Thompson vs. Springfield Water Co., 215 Pa. St. 275, 7 Ann. Cas. 473, 64 Atl. Rep. 210, 1905. *Georgia*—Fowler vs. Athens City Water Works, 83 Ga. 219, 9 S. E. R. 673 (1889), opinion by Bleckley, J. C. *owa*—Davis vs. Clinton Water Works Co., 54 Iowa (1890), opinion by Beck, J.; Becker vs. Keokuk Water Works, 79 Iowa 419 (1890), opinion by Robinson, J. *Wisconsin*—Britton vs. Green Bay Water Works, 81 Wis. 48 (1892), opinion by Ortoro, J. *Kansas*—Mott vs. Cherryville Water Co., 48 Kans. 12, 28 Pac. 989 (1892), opinion by Horton, C. J. *West Virginia*—Nicol vs. Huntington Water Co., 53 West Va. 348, 44 S. E. R. 290 (1903), opinion by Paffenbarger, J. *Nebraska*—Eaton vs. Fairbury Water Works Co., 37 Neb. 546 (1893), opinion by Ryan, J. *Missouri*—Howsmon vs. Trenton Water Co., 119 Mo. 304 (1893), opinion by Braco, J.; Metz vs. Water Works and Electric Light Co., 202 Mo. 324, 100 S. W. Rep. 210 (1906). *New York*—Wainwright vs. Queens County Water Co., 78 Hun. 146, 28 N. Y. Supp. 987; N. Y. Sup. Ct. (1894), opinion by Brown, P. J. *Indiana*—Fitch vs. Seymour Water Co., 139 Ind. 214, 37 N. E. Rep. 982 (1894), opinion by Howard, J. *Texas*—House vs. Houston Water Works Co., 88 Tex. 233, 28 L. R. A. 532 (1895), opinion by Brown, J. *Idaho*—Bush vs. Artesian Hot and Cold Water Co., 4 Idaho 618, 43 Pac. 69 (1895), opinion by Houston, J. *Ohio*—Akron Water Works Co. vs. Brownless, 10 Ohio Cir. Ct. Repts. 620 (1895), opinion by Caldwell, Jr.; Blunk vs. Dennison Water Supply Co., 73 N. E. R. 210 (1905). *Mississippi*—Wilkenson vs. Light, Heat and Water Co., 78 Miss. 389, 28 So. 877 (1900), opinion by Brother, S. J. *California*—Town of

Ukiah City vs. Ukiah Water and Improvement Co., 75 Pac. 773 (1904), opinion by Henshaw, J. *Louisiana*—Allen & Curry Mfg. Co. vs. Shreveport Water Works Co., 113 La. 1091, 1114, 37 So. Rep. 980 (1905), opinion by Provosty, I.

Considering the array of decisions against the liability of water companies, it almost seems useless to consider the matter further. But the property owner who is burned out feels that some one is at fault, particularly if he failed to carry any insurance, and is ready to assert that the water company made a contract to furnish water to extinguish fires on his property. This probably seems to him a reasonable interpretation of the city contract. Let us see if this is a proper view of the question.

In the first place the city provides a fire department with supplies, including horses, engines, hose, etc., and also a supply of water. The relation of the individual taxpayer to the company that agrees to supply water is no different from what it is to the person that sells the engine or hose to the city. The power of the city to contract in all cases is the same and derived from the statute. But if from the bursting of a defective hose or the breaking down of a defective engine, the extinguishment of a fire was made impossible, the owner of the destroyed property would have no right of action against the vendor, only the city would have a right of action for the value of the defective hose or engine.

I have heretofore only considered this subject as to the liability of the company under the contract with the city. But there is another feature of this subject that is of more interest to the management of water companies, and that is the making of private contracts for so-called fire protection. The last two words should be stricken from the vocabulary of every manager of a private water company, and no contract made with individuals or corporations for water should contain these words.

There has also been and is now a demand for connections for sprinkler systems. The applicant will tell you that as the company has a contract with the city to furnish water for extinguishing fires, that by providing water for a sprinkler system the company may be saved the expense of furnishing water in case of a large fire. If you ask him to sign a release of liability of the water company he will probably decline for personal reasons or because the insurance companies will decline to accept the risk unless they can have a chance to make the water company pay the loss in case of fire. The result is that the applicant for the connection feels aggrieved at somebody, and the usual thing is to take his satisfaction out on the water company by saying that it is to blame that he cannot save hundreds of dollars each year, but fails to state that the real reason was that the water company refused to become a co-insurer of his premises without consideration. Therefore, all contracts for water for hose connection to be used in case of fire, or connections for sprinkler systems should be carefully considered, and should contain the proper provisions as to liability. And I might suggest that a committee be appointed to consider and report a proper form for such a contract.

SEWAGE FILTRATION AT HEYWOOD, ENGLAND.

Showing twelve circular sprinklers of 60 feet diameter, with revolving arms and checkered brick walls.

EDITORIAL COMMENT

Value of Water and Water Power

Self Government of Cities

The Cement Trade

VALUE OF WATER AND WATER POWER.

The report by Mr. Adams in the article upon "The Value of Water," elsewhere in this number of MUNICIPAL ENGINEERING, of some of the testimony in the Kettle Brook case at Worcester, Mass., throws an interesting light upon the difficulties in the way of securing a full consideration of all the factors involved in the taking of a certain amount of water from a stream for municipal purposes.

Mr. Adams brings out in considerable detail the theory that the city takes water only, and not horse-power, and, from this point of view, his point is well taken, and the value of this water is not measured by the market value of the power generated by it, although it may be roughly proportional thereto. Probably most of the water powers on the Blackstone river below the diversion of 5,000,000 gallons for the domestic supply of the city of Worcester are developed by the owners of the water, so that they are not easily able to sepat a fixed level from the cost of supplying the machinery, buildings and structures necessary to turn the flow of this water into power. It would seem, however, that lawyers and engineers in Massachusetts would be reasonably familiar with the conditions in a number of streams in that and neighboring states, where a hydraulic company supplies water at a fixed level and the purchaser of the right to use that water supplies his own buildings, wheels, channels, etc., thus definitely separating the total cost of the power developed into the two parts, one of which seems to be the water ready to use, which was abstracted by Worcester in the case under discussion, and the other is the utiliation of the water and its fall, upon the actual value of which the action of the city of Worcester in making this abstraction had no effect, other than that the fixed charges of the operation of the plants were probably not reduced by the reduction in power, and so the cost per horse power of development was slightly increased.

One is curious about the effect of the return of this 5,000,000 gallons of water to the river through the sewers of the city, and as to how many of the eighty powers mentioned are below the city and so are but slightly affected, if at all, by the original diversion.

There is another side to the question which is not touched by Mr. Adams and may not have appeared in the case. It is probable that many of the water powers on the river are developed to their full extent, and that the minimum flow in the river before the diversion is demanded by the machinery installed. In such cases the abstraction of even the 12½ horse power, which is the average loss per mill site on account of the loss of the 5,000,000 gallons taken, might have a very serious effect upon the mill operations. It is clear that there would then be some damage beyond the mere loss of the water. This damage might amount to the closing of the mill during the lowest water stages, wholly or in part, or for a part of the day, or it might require the construction of an auxiliary steam plant. In case an auxiliary steam plant is already in use, it would require an increase in the amount of coal burned, at a time when the steam plant is carrying its maximum load, and might even require an increase in the steam plant.

Again, the horse power developed depends upon the amount of water supplied and the distance through which it falls, so that, independently of any question of cost of developing the power, the value of the water at a mill site with 20 feet fall is double its value at another site with 10 feet fall, so that

the measure of loss of water is not the amount of water alone, but the product of the amount of water by its fall, and the owner of the former can justly claim double the damage of the latter, without reference to the relative expenditures in utilizing their respective powers.

While the simple abstraction of the water from the mill powers between the reservoir outlet and the city sewer outlet might be measured by the theoretical horse power at each mill site, it is evidently equitable to take into account the conditions of the developments at those sites, and, if possible, to award to each owner additional damages, which would probably be greatest where there had been judicious development of the power to its limit, and would be less, possibly nothing, where power had been allowed to run to waste.

The true assessment of damages may, therefore, lie nearly as low as Mr. Adams would put it, and might, in exceptional cases, even exceed the maximum fixed by the court. If an average award should be made, it would lie somewhere between the upper limit set by the court and the lower limit set by its critic.

SELF GOVERNMENT OF CITIES.

MUNICIPAL ENGINEERING has often made the statements that each city has as good government as it wishes to have, and as good government as it deserves to have. These statements require some modification, however, to make them conform exactly to the facts in most of the States of the Union, for the citizens do not have full opportunity to choose their own form of government and must act within the limitations set by the law, so that in too many instances the State legislature has much to say as to whether a city shall have good government or not. It is not difficult for a legislature to put the control of the city in the hands of professional politicians under such conditions that it is practically impossible for those desiring better government to make the improvements they demand.

The monarchical form of government presents the theory that it requires expert guidance to secure good city government and, therefore, the general principles of city management and many of the details of the government must be fixed and imposed upon the city by the general government, and the city must conform to this set schedule. The city was forgotten when the forms of government of the United States were established, and most of the States have proceeded upon the old theory of city government.

The true democratic theory would accord to the city the same right of self government within its limitations that the constitution established for the States. Were this theory generally applied the statements made at the beginning would be strictly true. A few states are taking steps in this direction. At this time the little city of Grand Junction, Colo., is holding a charter convention and is determining the form of its government, subject to a subsequent vote of the people and more or less perfunctory approval by the legislature. Colorado Springs has just held its first election under a charter formed in a similar way. In these cities the citizens are able to secure the character of government which the majority of the citizens desires, first, by the election of officers pledged to certain courses of procedure, and second, by a recall of such officers if they fail to fulfill their pledges or are otherwise unsatisfactory.

It may be asserted in opposition to this method of securing home rule in cities, that, particularly in such small cities, there are few if any experts in city government resident therein, and that the mistakes of ignorance and inexperience may be quite as disastrous as the wrong doing of officers devoted to private gain, but this condition of ignorance under the new plan is likely to pass away, for when the people recognize that they are alone responsible for the character of their government and that they are not subject to the restrictions of a legislature unramiliar with local conditions they will un-

undoubtedly follow the lines of improvement which will open from time to time and select the officials who show their ability to perform efficient service and develop with the city.

Cities learn much from each other and for their mutual benefit it is quite desirable that they have uniform systems of accounting and reporting. Cities, like other business corporations, need some supervision in the way of checking up accounts of receipts and expenditures, in keeping their officials in the proper line of their duties. The city needs this supervision particularly because it is not a money-making but is a money-spending concern and its officers do not have the necessity of satisfying their stockholders regarding dividends on their investments as an incentive for special efforts. State regulation of such things as these is quite different from the imposition of a special form of government or a particular policy of administration and may be permitted as a public benefit.

Private corporations resent State regulation beyond certain limits, and municipalities may well follow their lead. Possibly the constitutional theory that the people reserve all rights not definitely delegated in that document might be brought into successful use in taking from the legislature powers which they have assumed with reference to the government of cities, and which really belong to the residents in those cities.

THE CEMENT TRADE.

The fifth edition of the Directory of American Cement Industries has just been issued in revised and enlarged form, and an examination of the book shows the development of the cement industry as compared with its standing when the fourth edition was issued in 1906. During the three years there has been an increase in the number of Portland cement companies of 50 per cent, the total now being 235, with frequent additions to the list. The number of companies actually making Portland cement has increased over 25 per cent and is now 109. The number of companies making or preparing to make cement of all kinds has increased over 25 per cent and is now 282. There has been a notable falling off in the number of natural hydraulic cement plants in operation, as is shown by the comparison of the increases in Portland cement companies and in companies of all kinds.

Thirty-seven States and territories of the United States are now represented in the list of manufacturers, and ten provinces and countries in the rest of the American continent, indicating that cement materials are widely distributed and that the manufacture and sale of cement is becoming more thoroughly localized each year, as is eminently proper in the case of so heavy and so cheap a building material.

An examination of the list of officials of cement companies and of the lists of members of cement manufacturers' associations indicates that there are a few well concentrated centers of interest, which, while not to be classified as trusts, show the advantages of co-operation or of the wide distribution of plants under the same or allied ownerships, but the number of independent plants and their wide distribution makes the problem of market for a cement plant very largely a local question, and this tendency has not been interfered with very seriously by any of the combinations mentioned.

The increase in the use of cement in three years is also shown by the reports of production, the increase in the production of Portland cement from 1905 to 1908 being 44 per cent and amounting in 1908 to 51,002,612 barrels.

Of the cement consumed in the United States 95 per cent is Portland of home manufacture and only 3 per cent is natural hydraulic cement, as compared with equal percentages in 1900 and almost a complete reversal in 1880.

The consumption of cement per capita has taken another long step and was 229 pounds in 1908 as compared with 181 in 1905 and 87 in 1900, and the end is not yet.

In the lists of names of persons engaged in various portions of the cement field, including contractors, dealers, sales agents, engineers, etc., the most notable increase is in the number of manufacturers of cement products, including the makers of artificial stone, blocks, posts and other articles in cement or concrete, and the users of reinforced concrete. The fourth edition contained the first attempt at a complete list of persons in this industry, and the list covered twenty-six pages and contained about 2,100 names. The list in the new edition covers thirty-seven pages and contains about 3,000 names.

A review of the book appears elsewhere.

THE QUESTION DEPARTMENT

Is Green Cement Coloring Poisonous?

I have built a rough stone grotto around and over a spring of drinking water, and I wish to point it up with green colored cement mortar. I do not know of any green mortar color that is not poisonous. Can you tell of any non-poisonous color? I will be glad to obtain the information.

C. E. H., Winchester, Va.

Can our readers offer any information of interest to our correspondent?

Plans For Cement Block Houses.

Kindly inform me where I can find a book of plans for cement block houses.

C. D. B., Chicago, Ill.

One or two portfolios of designs are on the market which are not satisfactory, because they do not pay sufficient attention to the difference of cement from other materials. The best books are those compiled by or prepared for the cement companies, such as the Universal Portland Cement Company, Chicago, Ill., or the Atlas Portland Cement Company, 30 Broad street, New York City, who will probably send a copy upon request. The Association of American Portland Cement Manufacturers of Philadelphia, Pa., also issues a book on this subject, for which a small charge is made.

Agriculture on a Sewage Filter.

I wish some information on the question of disposal plant. We have what we call a disposal plant. We run the sewer pipes into a catch tank, and from this tank into five others, and from these we switch the water onto a filtering bed; in sections of five parts, one section to each of the tanks. We turn on one section at a time, and when the bed is wet we switch to another. These sections amount to ten acres. Now, to get at what I want to know, would it be of any detriment to this bed to plant or run it in any kind of vegetation? If so, what kind of truck could be raised on it? Also, what manner of plowing should be done to keep the bed in proper condition.

D., Sherman, Tex.

Growth of vegetation on a filter bed would interfere to a considerable extent with its action as a filter on the one hand, and the large amount of water applied to the beds, if they are operated at the most economical rate, would interfere with the proper growth of the vegetation, so that the suggestion has its objectionable features from both sides.

What is termed "broad irrigation," or the filtration of the septic tank effluents through the soil, is practiced with more or less success in a few places, the most success being met in dry countries, where there is not enough rainfall to raise crops, and so it does not interfere with irrigation by the sewage. It requires considerable areas for this method of purifying sewage, otherwise the growth of the crops will be interfered with, the soil will become waterlogged, and then the purification of the sewage will be interfered with. A choice must therefore be made between sewage filtration and sewage irrigation, and in the case under consideration the first has been chosen. There are several books on sewage purification, which explain these differences in the processes, and there are numerous articles in MUNICIPAL ENGINEERING explaining the two named, and still others which are also in use.

Sewerage For a Small City.

It occurred to me you might help me solve a problem that is worrying me very much. My town has about 3,500 people, no sewerage system, and no money to put in one, as we are up to the limit on school building and water system. Our people

are turning their slops from sinks, closets, bath tubs, etc., into small streams, cesspools and on our streets, and, of course, make lots of unpleasantness for nearly every one. Please write me or give me the best information you can how to take hold of this situation. We have a deep well, cased down to 300 feet, as we were afraid of the water any nearer the surface of the earth. I am very much worried on this subject, and will appreciate the best information you can get me. If you haven't such information you see I want, please put me on the right track for it. I want all the sewerage information I can get for a town of this size.

H. G. E., Mayor, ———, Tex.

It is not very easy to build a sewer system without money. If a public system cannot be built and a company will not offer to build sewers under a system of charges for the service rendered, then the citizens will be obliged to take care of the matter themselves. In such cases the American plan is to provide cesspools, into which, in many cases, all liquid and solid refuse is discharged. These cesspools are made as porous as possible, and as a consequence the purification expected does not occur. This method is therefore very unsanitary, and often gives rise to serious nuisance. Better results are obtained if the solid garbage is drained of its water and disposed of by burning or burying, the liquids and human excrement being run into a water-tight cesspool, arranged for emptying whenever it gets full. Still better results will be obtained if earth closets are used for the human excrement, absorbent and dry earth being used to keep the place of deposit clean and odorless, and the boxes in which the deposits are collected being emptied at regular intervals where they can be of value to vegetation. Some years ago a paper by B. J. Ashley was published in MUNICIPAL ENGINEERING, in which he described a system of individual septic tanks for the houses in a vilage or small city, by the policy that it is fitting for the legislature to decide it. They say that it has been use of which much the same purification is obtained as in the large septic tanks in use for purifying the sewage of cities. This system is quite satisfactory, and reference may be made to the article referred to, or Mr. Ashley will send a description of the process upon application to him, at 6507 Normal Boulevard, Chicago, Ill. The overflow from these septic tanks is very nearly inoffensive if they are operated properly, and may be used for irrigation or discharged in other convenient manner, and when the city can afford a sewer system these outlets from the septic tanks can be connected with the sewers. In using this system the only separation necessary is that of the garbage, i. e., vegtable refuse, which will not readily decompose in the septic tank.

Many articles on all the processes above suggested will be found in MUNICIPAL ENGINEERING from its beginning down to date.

Effect of Sewage Pollution on Stream—Cost of Disposal Plant.

Will a sewer discharge of about 300 gallons per minute pollute a stream with a flow of 10,000 gallons per second; we mean would the pollution show down the river 150 miles? Our last Legislature has ordered our city to install a sewerage purification plant on the account of another city 150 miles below us taking its public water supply from the stream in which we dump our sewerage. We have a population of 8,000, and have no manufacturing enterprises using our sewers. If we are forced to install this purification plant what would be an approximate cost of such plant and what would be an annual operation cost, said plant to be such as would give a moderate degree of purification? Any light you could give us on this matter will be greatly appreciated.

L., ——— N. C.

The Legislature seems to have answered this question for all practical purposes by means of the action reported, although it would seem to one not acquainted with the local conditions that it had taken counsel of its fears rather than of the facts or possibilities in the case. Many years of observation and experience in work upon this line for local and state boards of health lead the writer to the opinion that the precaution demanded by the law is quite unnecessary.

Septic tanks could probably be constructed for say $6,000 to $8,000, and the cost of operation could easily be kept at or below $600 to $800 a year. Should subsequent filtration be required the cost of construction and operation would be multiplied by four or five, but it is hard to see how such filtration can be required in the face of the fact that the septic tanks are also unnecessary, unless this is only one of many cities on the stream and it is necessary for them all to purify their sewage.

Brick Carrier.

Will you please advise me if you have, or know who has, an arrangement for conveying brick to the layer? The thing I have in mind is made with rollers, on which the bricks are placed and carried down an incline to the layer. I know there is such a thing patented, and thought perhaps you could inform me where I could procure one or more.

J. B. D., Saranac Lake, N. Y.

Carlson & Theselius, 912 Granville avenue, Chicago, Ill., make an automatic brick conveyor which answers the description and is very satisfactory.

The Matthews Gravity Carrier Company, St. Paul, Minn., makes a carrier such as will meet our correspondent's needs.

Makers of Mail Boxes.

We are going to have free mail delivery and I would like to know the names of makers of mail boxes. G., Logan, O.

Following are names of makers of mail boxes, the last seven being makers of boxes for rural free delivery lines:

Barber Mfg. Co., Ashtabula, O.

Corbin Cabinet Lock Co., New Britain, Conn.

Dudfield & Klepper, Lathrop, Mo.

Forest City Foundry & Mfg. Co., Cleveland, O.

Wm. F. Heise Mfg. Co., 61 Union Park, Ct. Chicago.

Michigan Steel Box Co., Adrian, Mich.

Nicol & Co., 66 N. Jefferson, Chicago.

Phelps & Sons, 110 Pennington, Newark, N. J.

Phoenix Hardware Mfg. Co., Homer, N. Y.

N. F. Purcell & Co., 232 S. Clinton, Chicago.

Reading Hardware Co., Reading, Pa.

Samuel C. Tatum Co., 414 W. Water, Cincinnati, O.

Taylor & Baggis Foundry Co., Cleveland, Ohio.

Rural:

Briscoe Mfg. Co., Detroit, Mich.

Century Post Co., Tecumseh, Mich.

Hawkeye Pump Co., Washington, Ia.

H. E. Hessler Co., Syracuse, N. Y.

Kelly Foundry & Machine Co., Goshen, Ind.

C. A. Peck Hdw. & Mfg. Co., Berlin, Wis.

Welsh Co., Nankin, Ohio.

Street Width—Water Before Sewers.

What is the best division of the space in a 60-foot street; what width for the central driveway; what width for the sidewalks, to include paving and the cement tread, in residence part of town?

Should water works precede sewerage, or sewerage precede water works, in a town which has had no comprehensive system of either, but is now moving for improvement along these lines? Which would be the more satisfactory and economical in the end?

M., Kissimmee, Fla.

For a residence street the driveway need not be more than 24 feet wide unless provision for turning loaded freight wagons at any point is demanded, in which case the driveway should be 27 or possibly 30 feet wide.

Practically 5 feet is sufficient for the width of the cement walks, although 6 feet gives a more roomy effect.

For the light-traffic side residence street, therefore, a 60-foot street would be divided into 24 feet roadway, 10 feet in two cement sidewalks and 25 feet in two lawns, allowing 6 inches for each curb. By alternating the trees this gives room for four lines of trees along the street. The alternation leaves the trees far enough apart along the curb to allow the sun and air free passage to the lawn.

Occasionally the cement walk is laid next the curb, but the general opinion of those familiar with this position is in favor of the location of the walk next to the property line, excepting the abutting property owners, whose lots are given an effect of depth by the added width of lawn abutting the lots.

Some residence streets serve also as thoroughfares or as pleasure drives, and such streets require wider driveways, 30 feet say, or occasionally even more. These streets are likely to have more foot travel also, so that the cement walk should not be less than 6 feet and 7 or 8 feet may sometimes be required. This reduces the lawns to widths of 7 to 9 feet, allowing for only one row of trees.

Business streets require quite different treatment, the principles upon which they should be treated not being the same.

Water works ordinarily precede sewers, mainly because they are most needed and because sewers are for the carriage of refuse of certain kinds by water and there is usually not enough water for such purposes unless the water works system has been constructed. With care it is possible for a village or small city to enjoy a public water supply for some years before constructing a sanitary sewer system, but the ideal method would be the construction of water and sewer systems at the same time and the requirement of sewer connections at the same time that water connections are made. One or two other articles in this department will be of interest in this connection.

Electrolysis and Prevention of Its Effects.

Have you any work treating on electrolysis? If so, kindly advise also if you have treated the subject in your publication, advising as to number, page, etc.

Is connecting the street railway's rail with water pipe a success in preventing electrolysis? E. J. B., St. Johns, Mich.

The books on electrolysis by stray currents known to the writer are Michalke's "Stray Currents from Electric Railways" ($1.50); a paper on "Electrolysis of Underground Conductors," by Prof. G. F. Sever in the volume on "Electric Railways" of the electrical congress at St. Louis ($3); and a chapter on electrolysis in Houston and Kennelly's "Electric Street Railways ($1).

There are doubtless chapters in other books and articles in encyclopedias on the subject. It has been the subject of several committee reports and papers before engineering societies, and has been in several controversies in court, but the literature in separate book form is limited.

References to chapters in books and lists of articles on the subject in MUNICIPAL ENGINEERING will be found in vol. xxxvi, p. 244; vol. xxxv, p. 32; vol. xxxii, p. 19. Of the many articles in these lists the following may be of most direct application in this case: Vol. xxvi, pp. 232, 331; vol. xxiii, p. 349; vol. xx, p. 287; vol. xix, p. 74; vol. xviii, p. 1; vol. xvii, pp. 270, 349; vol. xvi, p. 84.

Kind of Pipe to Lay in Cinders.

I have two pieces of galvanized iron service pipe that are laid where there are cinders from the railroad, and the acids from the cinders seem to eat up the pipe. To prevent this I covered them with sewer pipe, but it was a wet and swampy place and although I took a good deal of pains,

I doubtless did not get it quite water tight. If I should use lead pipe instead of iron would this do away with the trouble? What weight of pipe ought I to use, ordinary pressure being 70 pounds?

O. O. L., Cannister, N. Y.

Can our readers offer any help to our correspondent? The drainage from the cinders would probably have even more effect on lead pipe than on the galvanized iron pipe. If the sewer pipe covering were filled with cement mortar it would probably protect the galvanized pipe from the water, if care is taken to make the mortar waterproof, in which case the mortar would be wet enough to form a thin coat of neat cement over the surface of the pipe, which should of itself be enough to protect the pipe from the chemical action.

FROM WORKERS IN THE FIELD

Practical Points from Practical People.

Contributions to this Department are invited. Give from your experience for the benefit of others. No matter about the style of the composition, the fact is what is want d. Use the Question Department for what you want to know; use this Department for what you can tell others.

How to Make Concrete Blocks with Wet Mixture.

To the Editor of MUNICIPAL ENGINEERING:

Sir: After years of experimenting we have found a simple and practical method of manufacturing wet mix concrete building blocks, which method we believe will give concrete building blocks a place beside other first-class building material.

The molds are filled with a rather stiff wet mixture of concrete. The facing for the block should be one part cement, and one and one-half parts coarse sand, which should also be a rather stiff, wet mixture. The facing is placed on the block in a ridge through the center the full length of the block. A piece of moistened cheese cloth that is wider and longer than the mold is then spread over the mold, and the face plate, which is perforated, is pressed on the cloth, the impression made, the face plate is removed and the cloth is stripped from the block.

A simple way of testing the method is to cover a little facing material with cheese cloth, and make an impression with a piece of carved molding.

The cost of 24-inch blocks based on labor at $2.00 per day, cement at $1.40 per barrel, and sand at $1.00 per yard, the body of the block being a four to one mixture, is as follows: smooth face piece, five cents; hammered face piece, six cents; and the rock face piece, eight cents. The full block (two pieces) smooth block, ten cents; hammered face, eleven cents, and the rock face, thirteen cents.

More defective walls are built by the use of too much lime in the mortar than any other cause. Mortar for wet-mix blocks requires but little lime, as the blocks are practically waterproof.

In all the walls made with our two-piece blocks the vertical joints are at the center of the open spaces in the walls, which is an advantage, as all vertical joints should be pointed or plastered over on the inside of the wall to insure a tight joint.

The molds are sanded before they are filled with concrete. The sides are higher than the ends in order that the face plate may be held in position when the impression is made. Wet blocks can be made faster and with less hard work than dry blocks, as there is no tamping and they do not require sprinkling and care after they are made.

W. D. MOORE & SON.
Creston, Iowa.

House Numbers in a Small City.

To the Editor of MUNICIPAL ENGINEERING:

Sir: I got my money's worth from your answer in the January number to the question about house numbering. The council here passed an ordinance fixing a system of one hundred to the block, and I took the contract. The most of the squares figured a rate of nine feet. When we started to put them up there was necessarily a lot of numbers omitted and, being a small town, everybody had a kick. The mayor and two of the councilmen wanted to change to something that would make the numbers run consecutively. After losing themselves as to how they would do it, I told them their ordinance was all right and was being followed literally. Then I read your answer and said: "Gentlemen, there is a better explanation than I could

make, even if I had written it myself. The people that are kicking will all forget it inside of a month, looking for the next sensation." Peace was immediately fixed, just as it is done at The Hague.

W. H. G., ——, O.

Books on Assessments for Paving and Sewers.

To the Editor of MUNICIPAL ENGINEERING:

Sir: In your June number of MUNICIPAL ENGINEERING I noted the question of J. W. T., Jackson, Ohio, asking for some work on assessments for paving and sewers for Ohio. He will find it in the third edition of Ellis' Municipal Code (published by the W. H. Anderson Co., of Cincinnati), which will give him the information he is after. "The Law of Special Assessments," by C. N. Hamilton, will give him what he wants in a general line. It is published by the Bobbs-Merrill Co., of Indianapolis. There is a new work on special assessments published by the W. H. Anderson Co. This may furnish J. W. T. with what he is after. Very truly,

E. P. WILMOT,
City Solicitor, Chagrin Falls, O.

Some Considerations of the Necessary Changes in Construction to Adapt Macadam Roads for the New Traffic.

To the Editor of MUNICIPAL ENGINEERING:

Sir: How and why macadam roads, which have formerly answered all the needs of general highway traffic for long periods of time with comparatively little attention as to maintenance, have proved unable to meet the new conditions has been stated many times with a very general agreement as to causes and defects. It is admitted that the macadam road is an entire failure under new conditions as to the following:

1. It is the cause of so much dust as to be dangerous to health and of very great damage to surrounding property.

2. From one to three years represents the entire life of macadam surface under the new conditions of traffic.

3. The combined shearing and suction effect of the low-bodied, heavy, fast-moving automobile traffic is the principal cause of such deterioration.

4. All old methods of constructing highways are of practically no value in the face of these new requirements.

These premises having been admitted by road engineers, they have been considering the remedy and have generally arrived at the conclusion that some form of bituminous binder properly applied is the only solution for the situation. From the accidental discovery of the effect of the heavy asphaltic oil found in California upon roads and the improvement of the application of this material attention has been mostly concentrated on some form of binder, which is sufficiently liquid to be readily applied to road surfaces.

As, however, little is known as to bitumen, the producers of such materials have generally turned on the market such goods as they could most reasonably supply, and which would appear to be possible for the purpose without any accurate determination as to the way in which they fulfilled the conditions or otherwise.

These producers have generally suggested and introduced such specifications and tests as would naturally advance their own material and eliminate as far as possible competing materials, and as a general rule road engineers have borrowed their specifications from these sources or at least have regarded them as precedents. The result is a confusion of ideas and a want of uniformity as to requirements, which makes it impossible to secure any knowledge as to the value of the different qualities in an asphaltic binder from actual investigations of the work done. There is little knowledge as to what tests are valuable as indicating bitumen with road building qualities and what are merely tests published and promulgated for special promotion and additional confusion of the issues. Specifications adopted even by the most eminent engineers contain tests which are of no importance, are entirely irrelevant or so difficult of accurate manipulation as to render them entirely valueless from an engineer's standpoint.

It is evidently advisable to consider the qualities which are needed in a binder for macadam roads. These are:

1. The largest possible percentage of asphalt which will admit of use with the method of application adopted.

2. The least possible amount of unevaporable material which is not binder.

3. Proper quality of the binder residue in the compound used.

These qualities are evidently purity, involving elimination of materials which are not bituminous, and which are merely useless residue; stability of the binder under temperatures changes, that is, the minimum changes of consistency from low to high temperature; proper adhesiveness of the binder, this depending upon the absence of non-adhesive hydrocarbons, such as paraffine.

These qualities are generally understood to be necessary in a bituminous binder for road building.

It has been established that a pure bitumen is absolutely impervious to water and will thoroughly resist the attacks of water. Further, it is known that a pure bitumen having the proper minimum of changes in consistency under variations of temperature will remain practically the same for long periods of time without deterioration.

It has been generally admitted that paraffine scale separates out in the course of time and destroys the homogeneous character of the bitumen. Beyond this little is definitely known, and all tests which attempt to define qualities in asphalt binder which have no relation to the

above-mentioned requirements are without value and may be an unnecessary limitation; sometimes, in fact, a direct tendency to inferior materials.

It is not proposed to go further into the question of the proper tests to be used in connection with the determination of the value of asphaltic binder for road building purposes. Practically all that we know in regard to the value of the binder is expressed in the foregoing tabulation.

The business of road building is burdened with too many tests which are possessed of no practical value. Common use of these tests is a detriment, not only to the engineer and the producer but to everyone who is engaged in the business of endeavoring to provide the best practical roadway durable under modern traffic without undue expense. The general rule has been to blame the material, and so much material has been used which is ill adapted for the best work that this is partially justified.

It would, however, be infinitely better if some measures were taken to provide a standard means of testing these materials, employing only such simple and necessary tests as will indicate the value of the binder from the engineer's point of view, and which our present knowledge of bitumens will justify.

Much depends upon correct construction, and it is proposed to deal with the points to be watched in the proper constructing of the road, not with the old macadam, but only with the method for incorporating bituminous binder.

It is evident that what is required as a binder for highways is asphalt. Cold tar is subject to too much change of consistency under exposure to be entirely suitable for this work.

If it were not for the expense involved in the construction of such a surfacing, it would undoubtedly be the best form of construction to use an asphalt of about the consistency of paving asphalt mixed with hot stone and laid while hot. The use of this material in a liquid form is simply a convenience in manipulation and admits of a cheaper form of application.

There are three general considerations in the construction or surfacing of highays, which affect the method to be used and the apparatus with which the work is to be done. These three forms of construction do not consider the mere oiling of road, which is only temporary dust-laying, and does not in any way increase the durability of the highway, acting only to suppress the dust nuisance a short period of time and being somewhat cheaper in application than water.

The best foundation for any road surface which can be used is a thoroughly compressed old macadam foundation, which has reached the limits of compression by the travel over it. In consequence of this, and of the fact that there are many hundreds of miles of macadamized road with excellent foundations that have been much traveled, no system would be complete which did not provide a method of surfacing such roads.

Macadam roads of which the surface is much worn present a very uneven appearance. Traffic over them usually takes the center of the road for the most part and the wear is confined to very narrow lines. On such a road, it will be impossible to apply macadam binder and produce a surface which will withstand any long continued wear without some previous preparation of the foundation to receive the binder. The voids in such a road are, ordinarily, practically completely filled, except for some loose stone and dirt on the surface, and it is an axiom that binder will not penetrate a dirty road and cannot penetrate a foundation of which the voids are practically filled. There are consequently two things to be done to the road before it is brought to grade and crown: 1. To remove the dust and dirt from the surface. 2. To scarify the surface until all such parts of the road which have presented a rough and uneven appearance are thoroughly loosened up.

Where the road is comparatively free from dirt and a considerable portion of new upper course has to be added to bring the road to the proper grade and crown, the first operation is not necessary, as the addition of the new clean stone and the absence of any thick layer of dirt on the road will make it possible for the binder to penetrate sufficiently far to form a thoroughly good surfacing.

It is evident that any proper method of producing this surface should be sufficiently durable to last at least from 5 to 10 years without any repairs or similar maintenance cost, and in order to accomplish this the condition of the road should be such that the binder should be able to penetrate at least from 1½ to 2 inches deep. It is evident, therefore, that the scarifying of the road should be so arranged that when the necessary addition of new stone to bring it to grade has been made and properly compressed by rolling, there should be at least 2 inches of this new surface through which the binder to be applied can penetrate.

The conditions of application in this method of resurfacing are such that the binder must be in liquid or semi-liquid form. Asphalt of paving consistency would chill upon reaching the stone, would not remain fluid sufficiently long to permit entering the voids thoroughly, would chill too quickly to adhere and would not take the coating of small mineral aggregate, which is necessary to fill the voids and finish the surface. The binder should, however, contain as large a percentage of asphalt as is compatible with the method of application, and general information has placed this percentage at about 60 to 80, the percentage being taken when the residue reached 100 penetration at 77 degrees F.

In some methods of construction it is customary to partially fill the voids of the upper course of stone with small mineral aggregate before applying the heated binder. It has been the writer's experiences, however, that a greater degree of penetration and a more durable surface is secured by leaving out the small mineral aggregate from the upper course in this method of construction and pouring the binder as soon as the upper course has been rolled. This applies particularly to resurfacing of old macadam roads.

The question of the method to be adopted in pouring the binder so as to get an even distribution over the surface has been considered quite extensively, and a number of different appliances have been put on the market for this purpose. The binder is sometimes heated in a large kettle carried along with the work and poured by hand from dippers, and while this has the advantage of maintaining the binder at maximum fluidity, at the same time the pouring is slow and expensive work. Sprinkling wagons have been built of various types for the purpose of spreading the binder, and these can be used to advantage in a number of cases, but have not yet satisfactorily fulfilled the conditions in all respects. The apparatus to be used in this work has not yet been properly considered up to the present and there is a great deal of room for improvement in the method and cost of the actual spreading of the binder.

If the upper course of stone in this method of construction has been left without attempting to partially fill the voids before applying the binder, there will be very little necessity for brooming except in such places as form slight depressions in the road after rolling the surface, and this elimination of the cost of a large part of the brooming is an item in favor of this method of construction.

The binder should be poured into the voids of the stone in such quantity that it will thoroughly fill the voids and slightly flush over the surface. The actual quantity required will vary according to conditions from 1¼ to 2 gallons to the square yard. The average quantity in most cases is about 1½ gallons.

If the upper course of stone is left without the voids being filled or partially filled with the small aggregate, the binder will penetrate the upper course almost immediately to the required depth, and the spreading and rolling of screenings can follow close after the sprinkling.

In the rolling of the screenings in this case a large amount is forced down between the stones in the upper course, thereby filling the voids and consequently the screenings should be spread in a thicker coat than is required if the voids have been partially filled before the spreading of the binder.

The coating of screenings should, however, in no case be thicker than ½ inch, but the process should be repeated, if necessary, after the first coat is rolled in. The question of the labor required depends somewhat on local conditions, but within certain limits it can be considered generally, and this question will be taken up in the next article.

HENRY TIPPER, New York City.

Results of Cleaning Water Mains.

In a paper before the Central States Water Works Association, C. O. Daughaday describes the methods and results of the cleaning of mains in Pittsburg, Pa. The pressure in part of the Hazelwood territory for five or six years kept gradually decreasing. This territory was supplied by an eight-inch supply main, about fourteen years old, passing through Schenley Park. At the end of this main the pressure was 34 pounds below the theoretical static head. A thorough survey was made of this main by means of pitometers, but no leaks could be discovered. In making these pitometer tests it was found that a coating of scale on the inside of the pipe greatly reduced the diameter. It was, therefore, decided to clean this main (some 3,200 feet) as an experiment. The scale taken from this pipe was carefully measured, and from this it was estimated that a coating of .32 inch (average) covered the entire last section of cleaned pipe, varying from one-eighth to three-quarters of an inch at different locations. In the cleaning two pieces of lead, caused by defective yarning, were removed, one of these weighing forty-five pounds. The results of the cleaning operation were as follows:

	Before Cleaning.	After Cleaning.
Diameter	7½ in.	6 in.
Velocity in ft. per second	5.3	10.3
Discharge, gal. per min.	730	1,620
Increase, per cent.		121

There were 3,264 lineal feet of this main cleaned, the discharge being taken by means of a 6-inch meter.

As the city had trouble in the dropping of the pressure in the Oakland district, where the mains were mostly old, it was decided to clean some of these. Following are the results of these operations:

Six-inch main on Bouquet street, Fifth avenue, South:

	Before Cleaning.	After Cleaning.
Diameter	5⅛ in.	6 in.
Coefficient of velocity	0.71	0.85
Velocity in ft. per second	4.26	11.56
Discharge, gal. per min.	370	1,019
Increase, per cent.		175

Six-inch main on Bouquet street, Frazier street, East; 1,800 feet cleaned:

	Before Cleaning.	After Cleaning.
Diameter	5⅛ in.	6 in.
Coefficient of velocity	0.76	0.90
Velocity in ft. per second	3.71	7.6
Discharge, gal. per min.	252	671
Increase, per cent.		166

Six-inch main on Ward street, Frazier street, East; 864 feet cleaned:

	Before Cleaning.	After Cleaning.
Diameter	5¼ in.	6 in.
Coefficient of velocity	0.79	0.88
Velocity in ft. per second	6.38	10.47
Discharge, gal. per min.	563	923
Increase, per cent.		64

This last main was comparatively new, and the inside was in fairly good condition, as will be seen by the coefficient of velocity being 79 per cent. before cleaning. This would account for the smaller percentage of increase as compared to other mains cleaned.

The velocity and discharge in this case, as in all other tests of mains cleaned this year, were determined by means of pitometers. The coefficient of velocity is the ratio between the average velocity and the maximum velocity of the pipe.

An interesting test was made in connection with the cleaning of a 4-inch main on Meyran avenue, from Fifth avenue, south, to determine the relation of the percentage of increase to the length cleaned. The flow was determined through the full length, 1,834 feet, before cleaning. The pipe was then broken, and at 905½ feet the flow was determined. After cleaning, the same process was followed out in the reverse order. Following are the results:

1,834 Feet:

	Before Cleaning.	After Cleaning.
Diameter	2⅝ in.	4 in.
Coefficient of velocity	0.77	0.85
Velocity in ft. per second	3.26	9.80
Discharge, gal. per min.	128	384
Increase, per cent.		200

905½ Feet:

	Before Cleaning.	After Cleaning.
Diameter	2⅝ in.	4 in.
Coefficient of velocity	0.73	0.82
Velocity in ft. per second	4.09	12.41
Discharge, gal. per min.	160	485
Increase, per cent.		203

477½ Feet:

	Before Cleaning.	After Cleaning.
Diameter	2⅝ in.	4 in.
Coefficient of velocity	0.72	0.83
Velocity in ft. per second	5.24	15.67
Discharge, gal. per min.	203	614
Increase, per cent.		199½

Another interesting test was made on a 4-inch line on Craft avenue, before and after cleaning, this line having been laid about forty years. At some places in this line the opening was nearly stopped up by tuberculation.

	Before Cleaning.	After Cleaning.
Diameter	2¼ in.	4 in.
Coefficient of velocity	0.47	0.76
Velocity in ft. per second	2.19	14.58
Discharge, gal. per min.	86	571
Increase, per cent.		564

As will be seen from these tests, the percentage of increase varies from 64 per cent. to 564 per cent. This determination of percentage of increase simply tends to tell us how dirty the pipes were when cleaned.

Destruction of Concrete by Alkali.

The following report by Wm. P. Headden, of the Agricultural Experiment Station at Ft. Collins, Colo., is deserving of greater circulation than it has had and is here given for that reason:

Cement has been found so generally serviceable and beset with so few disadvantages that its use is generally recommended without any reservation, and this confidence has been fully justified with but few exceptions so far as the limited literature at my disposal indicates.

The principal condition under which good Portland cement has failed to fulfill the requirements of the structure in which it was used, seems to have been where the structure was exposed to the action of sea water. Such exposure has not resulted uniformly in the destruction of the cement, so that even this condition, i. e., the exposure to sea water, a solution comparatively rich in magnesic chlorid and sulphate, may not have been the determining factor in the trouble noted.

The following case of deterioration may be of some interest as it presents some new points. There were sent to me some months ago a number of fragments of tiling which had been laid but from eight to nine months. They had been disintegrated to such an extent that one of the samples was simply a white putty-like mass mixed with sand. There was nothing about this sample remotely suggestive of concrete. Another of the samples consisted of a fragment of the tile, the interior portions of which had been wholly decomposed, while there still remained an outer and inner portion in good condition, or comparatively so. Another sample had been attacked on the inner side, leaving the mass of tile outside of the zone of decomposition apparently sound. The line of decomposition was sharply limited and showed distinctly, but even in this case there remained a thin layer of cement on the inside.

I do not know whether the tile were running full of water or not, probably not, as the fragments seem to be parts of 16 or 18 inch tile. The importance of this point is simply this, that it would answer any question in regard to the separation of solid "alkali" salts on that portion of the tile above the water line. That such a separation of these salts should take place does not seem very probable in this case.

The point of attack, so far as the sample sat my disposal indicate, is either in the center of the cement or near the inner surface. In either case we are almost compelled to assume the action of the water, i. e., of the salts held in solution. At the same time we see the resisting power of the outside and inside surfaces, which are evidently richer in cement than the inner portion of the mass of the tile.

I do not know the character of the water used. The sand used in making the

tile was quite fine. The proportion used was 5:1. We can readily see that the individual masses of cement in the interior mass of the tile must be small and readily attacked by solutions of salts capable of reacting with the cement.

It seems quite evident that the agents causing this disintegration of the cement must gain access to the interior portion of the mass of the tile in the form of a solution, but it is a question whether this solution is the same in strength and character as the water in the drain. I think that I have clearly shown elsewhere that the water-soluble portion of the soil is different from the salts held in solution in the ground water; further, that the ground waters are different from the drain waters, and the action of these waters on the tile would vary somewhat according to the source of the solution which penetrated the mass of the tile.

The drain waters obtained, say at a depth of four feet, contain as a rule a smaller amount of salts in solution than the ground water. The salts present are the same, but their relative quantities vary. The usual salts present in the ground waters are, sodic sulfate, calcic sulfate, magnesic sulfate, sodic carbonate, and sodic, in some instances also magnesic chlorid. In the drain waters we have the same salts but their relative quantities are different, the most notable feature being the relatively large amount of sodic carbonate.

The substances claimed to be the most active in effecting the disintegration of cement are the sulfates. In the case of sea water the explanation offered is that the lime of the cement decomposes the magnesic salts present in the water whereby the lime goes into solution and the magnesia is deposited in its stead, causing a bulging and disintegration of the work owing to its greater bulk. The principal magnesian salt in sea water is the chlorid, the deleterious action of which on cement is not established, but it has been shown that magnesic sulfate acts energetically. The most active agent in decomposing concrete is the sulfuric acid of the sulfates carried in solution. Again solutions of gypsum have been shown to act detrimentally on concrete by forming with the tricalcic aluminate a sulfo-aluminate.

The water acting on these tiles, whether it be ground water or drain water, is very bad. One of the two small samples sent to me contained 1252.6 grains per imperial gallon, of which 493.5 grains were sulfuric acid (SO_3) with an extremely large proportion of magnesia. The other contained 542.3 grains per imperial gallon, with grains of magnesic oxid or 7.8 per cent. of the total solids. I have examined a number of waters from this section and find the ground water uniformly heavily laden with the sulfates of lime and soda with comparatively large quantities of magnesia, especially if the water comes from near the surface, as it necessarily must in the case of drain waters. In addition to the above constituents, there is uniformly some carbonate present, which for the present purposes we may consider as sodic carbonate.

We have then an ample supply of these substances present which are known to act deleteriously upon cement, i. e., the sulphates, a portion of which is magnesic sulfate, and in addition there is so much sodic carbonate present that its action cannot be neglected.

For the present I will assume that the cement used was at least an average Portland cement with not more than two per cent. of calcic sulfate added. Assuming this to be correct, the action of the waters on the tile shows an interesting line of action.

A preliminary examination of the white decomposition product indicated the presence of a large amount of water, also of considerable quantities of sulfuric and carbonic acids. The decomposed mass was washed with distilled water to remove as much sand as possible. Examination of the wash water showed that it had taken sulfuric acid, lime and soda into solution. The portion soluble in distilled water may have been partly derived from other sources but probably came, for the most part, from the altered cement. The wash water, therefore, was evaporated to dryness and the residue added to the insoluble portion and the whole dried at 60 degrees C. The material thus prepared was submitted to analysis with the following results; with which is also given an analysis of a sample of the same brand of cement.

PORTLAND CEMENT DECOMPOSED BY ACTION OF ALKALI WATER.

	Original Cement.	Decomposition Product.*	Same Calculated on Water Free Basis.
SiO_2	22.55	10.98	14.16
SO_3	1.29	15.56	20.07
CO_2	1.07	9.39	12.16
Cl	not det'd	0.51	0.65
P_2O_5	.....	trace	.....
CaO	59.86	29.14	37.58
MgO	1.75	5.79	7.46
Al_2O_3	5.88	2.08	2.68
Fe_2O_3	4.83	2.51	3.23
Mn_3O_4	0.21	trace	.....
Na_2O	0.76	1.27	1.63
K_2O	0.63	0.29	0.38
H_2O Ignit. less CO_2	0.72	(22.48)	.....
	99.55	100.00	100.00

*6.01 per cent. sand deducted.

The loss on ignition in the analysis of the decomposition product agreed fairly well with that obtained by difference, but, owing to the presence of alkalies, carbonates and sand, the results of direct ignition are not to be relied upon except to show that the difference indicates the

amount of water present with reasonable accuracy.

The composition of the water acting on this tiling may safely be assumed to be represented by the following analysis of a sample of Arkansas river water, essentially a return water, taken at Rocky Ford.

The summation of the analysis presents a rather large excess over one hundred, which gives an excess of about one grain in the total amount of salts present. The excess of bases shown in the analysis as combined is not necessarily due to bad analytical work. The waters of our mountain streams show an excess of acids over the bases, but the alkalies forming efflorescences on our soils and alkaline waters, frequently show an excess of the bases, but seldom so large as in this case.

ANALYSIS OF ARKANSAS RIVER WATER, TAKEN AT ROCKY FORD.

Total solids per imperial gallon 156.4 grains.

Analytical Results.	Per Cent.
SiO_2	0.428
SO_3	48.299
CO_2	1.858
Cl	4.667
Na_2O	18.662
K_2O	0.326
CaO	17.090
MgO	5.993
Ignition	4.346
Sum	101.669
Oxygen equiv. to chlorin	1.051
Total	100.618

Combined.	Grs. Imp. Gal.
Calcic sulfate	64.942
Magnesic sulfate	27.994
Potassic sulfate	0.942
Sodic sulfate	32.449
Sodic chlorid	12.044
Sodic carbonate	7.007
Sodic silicate	1.358
Ignition	6.797
Sum	153.533
Excess sodic oxid	3.832
Total	157.365

The ground waters of the Arkansas valley have essentially the same composition; they of course, vary in the amounts of mineral matter, total solids, held in solution. The two small samples of drain water sent with these tiles illustrate this very well; one of them carried 1252.6 grains, while the other carried less than one-half as much, 542.3 grains in an imperial gallon.

The salient features in the composition of the salts present in the ground waters of this section are the large amount of sulfates and the presence of carbonates. The amount of chlorine or the corresponding chlorids is not large and they are probably subordinate agents in the alteration of the cement.

Mr. R. Feret says: "No cement or other hydraulic product has yet been found which presents absolute security against the decomposing action of sea water." Further: "The most injurious compound of sea water is the acid of the dissolved sulfates." Again the same writer says: "It is noteworthy, however, that chloride of magnesia is almost without action, while the sulfate of magnesia acts energetically upon cement."

It has further been established by Candlot, Michaelis and Deval, working independently, that calcic sulfate unites with calcic aluminate forming a hydrated sulfo-aluminate, which expands greatly on crystallizing and is soluble in water.

It is assumed that magnesic sulfate acts upon the calcic hydrate set free by the setting of the tri-calcic silicate, forming calcic sulfate, which is then capable of uniting with the calcic aluminate with bad results.

The ground waters found in the lower portions of our irrigated sections contain a mixture of the sulfates of soda, lime and magnesia, with which there is usually associated some carbonate. Some of these waters are essentially solutions of sodic sulfate with a little sodic carbonate; others, especially drain waters, contain calcic and magnesic sulfates with some carbonate, possibly sodic carbonate.

The knowledge of the fact that our drain waters contain carbonates led me to try the action of a mixture of sodic sulfate and carbonate on the coarsely ground concrete. This mixture attacked the cement rapidly, yielding a white decomposition product rich in carbonic acid. This result is no other than what we would expect. If the tri-calcic silicate in setting really liberates four molecules of calcic hydrate, as we suppose, the reaction should be accompanied by the liberation of a corresponding amount of sodic hydrate. The following formulae will make this point clear:

$$2(3CaO\ SiO_2)+9H_2O=2(CaO\ SiO_2)\ 5H_2O+4Ca(OH)_2.$$

The calcic hydrate liberated or very loosely held can readily act on the sodic carbonate as indicated by the following simple formula:

$$4Ca(OH)_2+4Na_2CO_3=4CaCO_3+8NaOH.$$

The sodic hydrate thus freed is capable of further attacking the silicates and possibly the aluminates, carrying silicic acid, alumina and lime into solution, probably as hydrated silicates. The treatment of the cement with a mixed solution of sodic carbonate and sulfate showed that it is a fact that calcic carbonate is formed and also that silica, alumina and lime do go into solution and that too without the aid of free carbonic acid.

No care was taken to make the solution of mixed salts even approximately of the same strength as the ground waters, and no ratio between the salts was observed, simply, that the solution was a weak one; two to three grams of sodic carbonate to the liter with five or six grams of the sulfate. The time of the experiment was 14

hours. The time was short, and the solution not as rich in salts as some of our ground and drain waters. The tiles, on the other hand, are exposed to the action of similar solutions, some weaker but others stronger, from the time of being laid till taken out, in this case eight to nine months. In view of these considerations it is not strange that the mass of concrete should be softened and destroyed.

Using the results of these rather crude experiments, we may interpret our analyses as indicating that the cement has been deprived of silicic acid; it originally contained 22.50 per cent., but the hydrated decomposition product contains only 10.98 per cent., or 14.16 per cent., calculated on a water-free basis. While the ratio of the weight of the decomposition product to the original weight of the cement is not known, there is no evidence that there has been any increase in the weight which would invalidate the preceding observation and a second experiment with cement and a solution containing sodic sulfate and carbonate leaves no question about the removal of silicic acid, alumina and lime by waters containing these salts. The analyses also suggest the removal of a relatively large amount of lime. The cement contains 59.56 per cent. of lime, while the alteration product contains but 37.58 per cent. (calculated on a water-free basis). Further the ferric and aluminic oxids have been reduced to about one-half as much in the decomposed cement as there was in the original. The sodic sulfate, more particularly the calcic and magnesic sulfates which are present in the ground water, will at the same time act on the tri-calcic aluminate, forming the sulfo-aluminate, $2(3CaO\ Al_2O_3)+5CaOSO_3$, which crystallizes with 60 molecules of water and is soluble. That these reactions really have taken place is indicated by the increase of the sulfuric acid, SO3, which amounts to 20.07 per cent. and likewise of the carbonic acid, which amounts to 12.16 per cent. of the water-free decomposition product, while they amount to only about 1.0 per cent. each in the original cement.

That the magnesic sulfate also participates in producing the deterioration, is indicated by its presence in the altered cement to the extent of about five times the amount present in the original; i. e. 7.46 per cent. in the water-free alteration product against 1.75 per cent. in the original.

The changes effected in this case are quite consonant with the views quoted, excepting the formation of so large a proportion of carbonate, evidently calcic carbonate, due to the action of the sodic carbonate in the ground water. The presence of sodic carbonate in a solution so rich in lime may seem improbable, but this has been shown to be not only possible, but a fact.

This alteration product differs materially from those produced by the action of sea water on the works at Aberdeen and analyzed by Prof. Brazier, according to whom the chief decomposition products were carbonate with calcic and magnesic hydrates, while the amount of the sulphuric acid was scarcely altered at all. The analyses indicate a removal of the ferric and aluminic oxids from the interior portions of the work, and an increase of them in the outer portions. The authors after giving the analyses justly make the following statement: "We may observe with respect to these analyses that both in the case of the original cement and the deteriorated concrete, there are many matters which we are quite unable to reconcile."

The action of the ground waters seems to have been one of chemical change, converting the lime of the cement into a sulfate and carbonate, accompanied by the removal of silicic acid, alumina and lime and totally destroying the cohesiveness of the concrete.

The samples of deteriorated tiles sent to me do not justify any inferences whatever in regard to the part that may have been played by the expansive force of newly formed crystallizable compounds. The thickness of the tile and the amount of material involved is so small that this factor is negligible and the results presented are probably wholly due to chemical action.

This subject is of some importance, as concrete structures, bridges, culverts, foundations, etc., are being erected in places where they will be subjected to the action of such waters.

Most of the cretaceous shales are, so far as my observation goes, rich in alkalies, calcic sulfate, etc., and concrete foundations laid in these may be acted on prejudicially.

Modern Lighting System for Mishawaka.

To the Editor of MUNICIPAL ENGINEERING:

Sir: Mishawaka, with its St. Joe river and manufacturing facilities, has long been known as "The City of Power." Today this is changed to read "The Indiana City of Light and Power."

For years Mishawaka had been content with arc lamps hanging from ropes suspended high above the street on poles. These, scattered along from square to square, gave light to the crossings, throwing the rest of the thoroughfares into shadows.

Early in the year the Business Men's Association, made up of Mishawaka boosters, decided that if the city could have plenty of power it ought to have light in keeping. Immediately plans were made for a revolution in the city system. Many suggestions were made for improving the old arrangement, but finally a column about 15 feet long with lamps dropping over from the top, was decided upon.

The job was given to the Dodge Manufacturing Company, of Mishawaka, power transmission engineers, and in short order the new posts complete were delivered and

placed in position fifty feet apart over the entire business section.

The posts are a combination of cast and wrought iron, resting on a 16-inch square base. They were made in three sections, the first two being of 3 and 4 inch pipe joined by castiron fittings. Two arms drop over from the side posts, while four are used for the corners. These are made of 1½-inch pipe with fancy scroll supports. The width between the post and the arms is 20 inches. The side posts have two drop lights with one at the top; the corner posts have five Tungsten 16.40 k. w. lamps in milk colored globes which turn night into day. The posts are white.

The new system makes a brilliant light, flooding every nook and cranny of the shopping center. Mishawaka has a population of about 12,000 and is perhaps the only city of its size in the country supporting a lighting system of this kind. It is an innovation that others are likely to follow.

C. R. TROWBRIDGE,
Mishawaka, Ind.

MUNICIPAL MATTERS IN COURT

Higher Courts—Indiana Road Law not for Streets—Des Moines Paving Assessments—Pavement Defined—Violation of Regulations

Decisions of the Higher Courts of Interest to Municipalities.

BY J. W. KENNEY, ATTORNEY, INDIANAPOLIS, IND.

Franchise to Gas Company—Provisional Payment to City.—Where a city grants a franchise to a gas company, authorizing it to furnish to the city and its inhabitants natural gas for light, heat and power in consideration of which the company agrees to pay the city annually $300, a further provision that such payments will continue only as long as the company enjoys its franchise without competition, is not contrary to public policy, as tending to destroy competition and create a monopoly. —Richardson Gas & Oil Co. v. City of Altoona (Kan.), 100 P. 50.

Lot Owners Right of Access to Street.—Lot owners have an easement in the street fronting their property of a reasonable ingress to and egress from their lots, both on foot and with vehicles, and are entitled to have the street maintained as a street for the use of their properties, and the city can not cede the right to a railroad company to use the street exclusively for its purpose.—Stein v. Chesapeake & O. Ry. Co. (Ky.), 116 S. W. 733.

City Can Not Obstruct Street by Depot. —A city can not, unless specially authorized by the legislature, permit obstruction of a street by a depot extending across it.—State v. Louisville & N. R. Co. (Ala.), 48 So. 341.

Provision Upon Franchise in City Charter Is Mandatory.—A city charter provision declaring that no franchise shall be granted by the city council merely for consideration of public utility and advantage, but that every application for a franchise shall be published and competitive bids invited, and that such franchise, if granted at all, shall be awarded to the highest responsible bidder, is mandatory, and exclusive of all other methods of granting franchises.—Gill v. City of Lake Charles (La.), 48 So. 440.

Viaduct Not a Nuisance.—A viaduct constructed over a street, as authorized by municipal ordinance and in conformity therewith, is a structure authorized by law and is not a public nuisance.—Crofford v. Atlanta B. & A. R. Co. (Ala.), 48 So. 366.

Contract with Water Company Creating a Monopoly.—A contract between a city and a water company's assignor, by which the city agreed not to grant to any other person the right to furnish water for fire hydrants during the life of the contract, etc., was invalid as a "monopoly" in violation of Const. Art. 1, Sec. 3, prohibiting the granting of a perpetuity or monopoly.—Hartford Fire Ins. Co. v. City of Houston (Tex.), 116 S.W. 36.

Condemnation of Land for Street.—Iowa Code, Sec. 784, authorizing cities to construct embankments necessary to retain the street at grade and to purchase or condemn land suitable therefor, contemplates the acquisition by purchase or condemnation of additional land adjoining a street on which to construct a necessary retaining wall.—Patterson v. City of Burlington, 119 N. W. 593.

Consolidation of Municipalities.—Under Code 1907, Sec. 1126, authorizing the consolidation of municipalities lying contiguous to each other, one municipality can not be annexed to another where territory

belonging to neither intervenes between them. (State v. Martin [Ala.], 48 So. 847.)

City Council's Delegation of Functions.—Functions which are purely executive, administrative or ministerial, may be delegated by a city council to a committee, and it is only such functions as are governmental, legislative or discretionary which can not be delegated. (City of Biddeford v. Yates [Me.], 72 A. 335.)

Ordinance Authorizing Committee to Lease Property.—An ordinance authorizing the committee on public property of the city council to lease any part of public buildings not already under lease or appropriated to the use of the city government, for not exceeding three years, upon such terms as they may deem expedient, subject to the approval of the mayor and aldermen, is a valid delegation of the power of the council, since it invests the committee with ministerial power only. (City of Biddeford v. Yates [Me.], 72 A. 335.)

Materials for Improvements—Bids for Contracts.—Under Acts 1908 (p. 170, c. 10) providing that after expiration of the time for objections to the pavement of a street, the mayor and council shall adopt a resolution expressing the determination to proceed with the improvement, defining its character and stating the material to be used, it is the duty of the mayor and council to select under one resolution and for one contract one particular kind of material, and they can not designate several materials and provide for the making of bids for each. (Oklahoma City v. Shields [Okl.], 100 P. 559.)

Judgment Against City for Contractor's Negligence—Liability.—Where a city contractor, though requested, refused to defend an action against the city for injuries to a third person occasioned by the contractor's negligence, and acquiesced in an appeal by the city from the judgment against it to the extent of expressing the hope that the city would win, the city was entitled to offset against the claim of the contractor, not only the amount of the judgment recovered by the third person, but also the money legitimately expended on the appeal. (Murphy v. City of Yonkers [N. Y.], 115 N. Y. S. 291.)

Damages for Change of Grade.—Under the laws of New Jersey (1889 p. 378), an assessment for damages to the owner of a building erected on any street, the grade whereof has been changed by the city, must be limited to the damages resulting to the buildings, and an award based on the depreciation in value of the entire property is illegal. (Delaware L. & W. R. Co. v. city of Summit, 72 A. 83.)

Assessment Against Property Benefited by Improvement Under Former Charter.—The fact that under Portland City Charter 1898, Sec. 127, under which a local improvement was made, the contractor was required to look solely to the property affected by the improvement and the owners thereof for compensation, would not preclude the city under its subsequent charter from exercising the power to charge the property benefited by the improvement with a lien for its share of the cost. (Hughes v. City of Portland [Or.], 100 P. 942.)

Act for Sewerage Assessment Mandatory.—Act Feb. 19, 1895, providing that where sewers are constructed forming a part of a general system of sewerage it shall be lawful to assess benefits not only upon the land fronting on the line of the sewer, but also upon all lands throughout the entire sewerage area in the municipality, is mandatory, and assessments for benefits from the construction of sewers must be in conformity therewith. (Simmons v. City of Millville [N. J.], 71 A. 1135.)

City's Prescriptive Right to Ditch.—Where a ditch had been dug for more than ten years, and continuously used since that time to carry off water falling upon a certain area of the city, the city obtained the right by prescription to maintain the ditch; but the right was limited by the character and extent of the period of prescription, and it could not thereafter enlarge the ditch, either by actual excavation or by increasing the flow of water. (Sturges v. City of Meridian [Miss.], 48 So. 620.)

Construction of New Walk Not a Repair.—The Buffalo city charter, Sec. 288, requires the owner or occupant of premises to lay and relay sidewalks whenever ordered and to keep the sidewalk in good order and repair. It also requires that the commissioner of public works shall notify the owner or occupant of any premises in front of which any such work, except the removal of snow and ice and the repair of sidewalks, shall be required to be done, and if the same is not done by the owner or occupant within ten days, it shall be done by the city and the expense assessed against the property. There was a plank sidewalk five feet wide in front of plaintiff's premises, which plaintiff was directed to repair, and after he had failed to do so, the commissioner caused the entire work to be removed and constructed a new concrete walk 17½ feet wide, the cost of which was assessed against the premises. *Held*, That the construction of such new walk was not a repair, but was a reconstruction, which the commissioner had no authority to make except pursuant to a resolution of the city council after notice to the property owner and an opportunity to be heard. (Konowalski v. City of Buffalo [N. Y.], 115 N. Y. S. 467.)

Open Stairway Upon Sidewalk—Negligence.—A city was not negligent in permitting the existence of a stairway leading to a basement in a sidewalk next to and parallel with a building, into which opening one nearly blind walked; the place being lighted, a rail running parallel with the building along the outside side of the opening, and there being 6½

feet of sidewalk in width after taking out the opening. (Elam v. City of Mt. Sterling [N. C.], 117 S. W. 250.)

Obstruction of Stream by Small Culvert.—Where a street obstructs a stream by providing too small a culvert to pass the water, the city's liability is not affected by the fact that the culvert was outside the city limits, nor by the fact that it did not originally construct the street; its maintenance of the obstruction after the city limits were extended to include the locality being sufficient to create the liability. (Martin v. City of St. Joseph [Mo.], 117 S. W. 94.)

Bond Issue for Sewer Systems—Invalid Election.—When the question of issuing bonds for the construction of two distinct sewer systems in different parts of a city and levying an annual tax for their payment was submitted to the voters of the city as a single proposition, so that they had no other alternative than to vote for or against both systems, the submission was invalid. (State ex rel. City of Joplin v. Wilder [Mo.], 116 S. W. 1087.)

Limitation Upon Maturity of Bonds.—A requirement (under Rev. St. 1889, Sec. 6353, as amended by Laws of 1901) that bonds issued by a city to cover indebtedness shall be payable in not less than 5 nor more than 20 years from the date thereof, "at the option of the city," such option is intended for the benefit of the city, and may be waived. (State ex rel. City of Carthage v. Gordon [Mo.], 116 S. W. 1099.)

City Maintaining Water Plant—Obligation to Consumer.—Where a city having power to maintain a water works system to supply its inhabitants furnishes an inhabitant with water regularly for a period of years, the rates being promptly paid, an implied contract exists upon the part of the city to supply the water; and it may not arbitrarily shut off the supply and deprive the customer of its contract privilege. (Delaware L. & W. R. Co. v. City of Buffalo [N. Y.], 115 N. Y. S. 657.)

Street Railway—Right of Way Over Tracks.—A street railway company does not acquire by its franchise a paramount right to a traveller in the street, as does an ordinary freight and passenger railroad over its right of way. (Bremer v. St. Paul City Ry. Co. [Minn.], 120 N. W. 382.)

Indiana's Three-Mile Paving Law Not Applicable to City Streets.

A decision was rendered July 12, by Charles T. Hanna, of Indianapolis, Indiana, acting as special judge, in the Main street brick paving case, at Rushville, Indiana. The decision sustained the remonstrators against the improvement and dismissed the petition for the improvement of Main street with brick under the three-mile law limit.

Unlike other decisions which have been rendered in other cases, Judge Hanna did not declare the law unconstitutional, but based his decision on the fact that it was not the intent of the legislators to pave the streets under this law. The case will be appealed to the supreme court.

Des Moines Paving Assessment Cannot Be Collected.

An opinion was rendered by Judge McHenry in the district court at Des Moines, Iowa, July 1, holding that the city was without jurisdiction to collect the paving assessments in the vicinity of Ridge road, Twenty-ninth street and Forest drive, for work done in 1907, because of a defect in the notice of publication. He also held that the work was never accepted nor approved by the board of public works, and that it did not come up to the specifications in the contract. Under this ruling the Barber Asphalt Paving Company, which did the work, cannot collect any money from the city for the work. The assessment aggregates 12,000.

Pavement Defined Under Indiana Law.

In a decision rendered by Judge J. L. Kirkpatrick July 13, at Kokomo, Indiana, he dissolved the temporary restraining order brought against Walter J. Dixon, who holds the contract for the improvement of North Union street with brick on a stone foundation. The decision involves a question that has been raised in several cities, and is, therefore, of considerable importance. The contractor, acting on the theory that a similar decision on a permanent injunction suit will be rendered, began work at once on the street and will assume all risk.

In dissolving the temporary injunction, Judge Kirkpatrick held that the term "pavement" had a fixed and comprehensible meaning, and that the intent of the law was that the property owners had the broad right of changing by petition the entire character of an improvement within ten days provided by the act, and that the right of change was not restricted merely to the surface of the street, but that "pavement" included the foundation as well. He held that the contention of the asphalt interests that a concrete foundation only could be used, despite the will of the property holders, was in violation of the meaning of the law, which enabled the property owners within the ten days provided to select any suitable material for the street as a whole, foundation and surface, specified in the act.

Violation of Regulation Not Ground for Withholding Service.

The New York State Public Service Commission, according to press reports from Albany, N. Y., has ruled that a gas company has no legal right to withhold the supply of gas from a consumer because the consumer has failed to install service pipes of a proper size, to comply with rules prescribed by the company.

SEWERS AND WATER

Sewage Disposal and Stream Pollution—Manila Water Works

Sewage Disposal Plants and Stream Pollution.

The following brief statement of the condition of the problem of sewage disposal in the various states of the Union is abstracted from the report of the committee on the pollution of streams of the National Conference of State and Provincial Boards of Health, of which committee Alec. H. Seymour, secretary of the New York Department of Health, was chairman:

Studies of conditions all over the United States and reports of State Health Departments show that there have been many epidemics of typhoid fever directly due to this practice. That in many cases public nuisances have been caused and that many of the waters of the various states are rendered unfit for domestic and manufacturing purposes. Fish life has been destroyed and the water ruined for boating, bathing and fishing and rendered objectionable and obnoxious in other ways.

The report shows that during the past few years many laws have been passed dealing with this subject, but that the legislative activity has not kept pace with the needs.

Taking up the work that has been done in the various states and the conditions existing, and reviewing them, the committee shows that the question is one of widespread importance, with which the various state boards of health of the country have been deeply concerned.

Massachusetts has studied the subject carefully. The work of their state board of health is most excellent.

In New Jersey there are 54 sewage purification plants installed and their policy is to allow no untreated sewage to be discharged into the waters of the state. Twenty-two places are now under orders to install sewage purification plants, and all municipalities and individuals discharging raw sewage into the Delaware river are under orders to cease doing so.

Ohio has an excellent law. The State Board of Health with the approval of the Governor and the Attorney-General, has ordered sewage disposal works to be installed in four of their cities. Marked progress has been made in Ohio in the freeing of their streams from pollution.

The California State Board of Health is constantly working in the cities and towns to purify the sewage, but it is stated that their streams are so large that the dilution in most cases prevents a serious nuisance being caused. Their principal objection is against sewage being allowed into streams and they haven't thoroughly awakened to the necessity of prohibiting the rapidly increasing population of the state to further pollute their waters.

In Florida it is stated that many towns and cities, particularly in the interior, use sewage filtration plants. Three cities discharge into tidal waters.

In Maryland it is found that the City of Baltimore is putting in an elaborate sewage filtration plant. Much excellent work is being done in preventing further pollution of their streams.

The Rhode Island State Board of Health has been working with the United States Geological Survey in the examination of the pollution of a number of their streams, and they are making a good advance.

In New Hampshire there is not a single sewage disposal plant in operation. They prohibit the pollution of lakes and streams used as public water supplies.

Indiana has just taken the question up seriously, and it is stated that the problem of the water supply for the cities of Indiana is a serious one. Water must be taken from the streams, as the ground water supply is rapidly giving out, except in the northern part of the state which is in a lake region.

In Texas the matter is beginning to assume serious proportions, and it is stated that they must begin the work of protecting their streams at once.

Colorado, Minnesota and New York report that they have been unable to get remedial legislation to fully protect their streams.

Kansas has about 15 disposal plants in operation, but has a very striking and workable law.

While there are over 50 disposal plants in operation in the state of New York, the legislature refused to give the state commissioner of health authority to deal effectively with this subject. A careful study has been made during the past year of the pollution of the oyster beds around Long Island.

The serious consequences of permitting the discharge of raw sewage into the streams of the country by the rapidly increasing population of the cities is depicted.

Legislative attention to the subject is demanded and the widespread idea that the streams of the country are natural sewage carriers is denied.

The question of interstate streams is fully considered and it is shown that as the Federal government has no control at

the present time over the matter of the pollution of streams, many of the most difficult questions cannot be solved at present. This might be done by agreement between the states.

The recommendations of the report are that inasmuch as any discharge of organic matter into streams used as public water supplies is dangerous to the public health, it is recommended that such practices be disapproved. That as an excessive discharge of organic matter into a stream creates a public nuisance, and restricts its normal use and enjoyment, it is recommended that partial purification be practiced in such cases. That state boards of health present at every opportunity to the people generally the importance of the matters involved and that those states not having effective legislation shall endeavor to secure the same. That the control of this work shall be placed in the hands of state boards of health, and not of separate commissions, and that the federal government be given such control that it may be in a position to assist the states in studying special problems; that there may be authority granted to prevent further pollution of interstate streams and lakes, and that the bill introduced in Congress last year, giving Surgeon General Wyman, of the United States Public Health and Marine Hospital Service, these powers be indorsed, and that the question continue to be studied and further reports secured by the conference.

Manila's Water Works.

The inauguration of Manila's new water supply marks the completion of a project of great importance to the city. The new water supply is taken from the Mariquina river, twenty miles northeast of Manila.

The watershed above the point of diversion covers about 140 square miles of mountain and forest, and is withdrawn from settlement. Private property within this reservation will be expropriated, and the entire district will be freed from human contamination forever.

The reservoir is rectangular in plan, and measures 509 by 764 feet, and is 20 feet deep. Its capacity is 50,000,000 gallons. The water enters through a concrete-lined conduit four and one-half miles in length, of which a small amount lies near the surface of the ground and was constructed in an open ditch; the balance is in a tunnel, which at the deepest point is 180 feet below the surface of the ground.

At frequent intervals along the conduit are inclined shafts with steps for entering the tunnel to inspect, clean or repair. At one point the conduit sinks under the bed of the Dulutan river, and at another it is carried across a stream by a sixty-foot concrete-arch bridge.

The water is carried from the headworks to the tunnels by means of a riveted steel pipe line forty-two inches in diameter and ten and one-half miles long. The pipe is carried under the Mariquina river, but this section, in place of steel, is of cast iron. Most of the other streams are crossed by means of concrete bridges; but at two points the pipe is carried across by steel truss bridges where the width of the stream is too great for concrete.

The dam is 400 feet long on the crest and about eighty-five feet in extreme height. It is built of cyclopean masonry, or concrete in which large stones are embedded. Behind the dam will be a storage basin which will serve the city during the dry months, when the discharge of the river is less than that necessary for the supply.

The cost of the completed work is about $1,500,000 as far as the Deposito, and the distribution system to be installed throughout the city will cost $500,000 more.

The new system supplies 22,500,000 gallons of water each twenty-four hours—enough to give every man, woman and child in the city 100 gallons a day.—*The Colonial Review.*

CURRENT INFORMATION

Electric Current Rates—Gas Meter Tests—Jamestown Bids on Work—Prizes for Bridge Designs—German Artificial Stone Paving—A Mammoth Stone Crusher

Rates for Electric Current in Boone, Iowa.

A special election will be held at Boone, Iowa, August 16, to ratify a franchise granted to E. E. Hughes, J. H. McBride and Andrew Stevenson, for operating an electric light plant and street car and heating plant in that city. The power schedule incorporated in the franchise provides for flat rates from 9c to 3c per kilowatt. This compares favorably with the power rate in any city in Iowa. On the last reading, however, an even more favorable rate was adopted than originally contemplated. As amended, the rate is as follows:

40 k. w. hours per month 9c per k. w.

40 to 50 k. w. per month 8c per k. w.
50 to 100 k. w. per month 7c per k. w.
100 to 200 k. w. per month 6c per k. w.
200 to 300 k. w. per month 5c per k. w.
300 to 400 k. w. per month 4c per k. w.
400 and over per month 3c per k. w.

The minimum charge for power is $1 for a horse power, 50 cents for each additional horse power, and no minimum for any consumer to exceed $5.

The light schedule is as follows:
Up to 20 k. w. hours 13c per hour.
20 to 40 k. w. hours 11½c per hour.
40 to 80 k. w. hours 10c per hour.
80 to 160 k. w. hours 8c per hour.
160 and over 6c per hour.

Gas Meter Tests by New York Commission.

The Public Service Commission, which has been in existence in New York two years, has tested 655,248 gas meters. Of that number 513,828 were meters previously used which had been removed and repaired by the gas companies, and were tested by the commission before being put into use again, and 130,142 were meters that had never been used. On complaint of gas consumers 11,278 meters were tested. These tests showed that 4,536 meters, or 40.2 per cent. were more than 2 per cent. fast; 1,249, or 11.1 per cent. were more than 2 per cent. slow, the rest, amounting to 48.7 per cent., ran between 2 per cent. fast and 2 per cent. slow. The value of meters tested is about $3,500,000.

A statement was made by Robert E. Livingston, for the Consolidated Gas Company, who said that the commission had tested 3,460 meters of that company on complaint of consumers during the two years of its existence. Of that number 1,619 were correct, and the rest fast or slow. He stated that these tests cost the company $752.75 in the two years, and its customers $1,129.45. Under the law, the consumer pays for the test of a meter when it is found to be correct or running slow. The company has to pay for the test and install a new meter where it is found to be running 2 per cent. or more to the detriment of a consumer.

Jamestown, N. Y., Bids On Its Own Work.

The board of estimate of the city of Jamestown, N. Y., has decided upon a novel plan for developing competition among contractors. The city is to bid on contracts, just as any other bidder. The bids are to be submitted for the city by the city engineer, and if it is the lowest bidder it will be awarded the work. Recently when several bids were opened, the city's figures were materially lower than any of the others, and considerable discussion was aroused as to the proper and legal status of the proposition. The question was finally referred back to the board of estimate and review for settlement. It is believed that the fact that a city or county would bid for public work might have the effect of causing contractors to figure more closely on municipal work. The same plan is in successful operation in Toronto, Ont.

Prizes for Minneapolis Park Bridge Designs.

The board of park commissioners of Minneapolis, Minn., contemplates the connection by water-ways of the lakes of its park system and will receive designs, detail plans, specifications and estimates for several bridges of design suitable to the surroundings, until 5 p. m., September 1. The bridges are to be of concrete, stone or a combination of both. For the purpose of obtaining such designs and plans from expert bridge engineers and architects, the board has offered $1,500 in three prizes as follows: First prize, $800; second prize, $500; third prize, $200. Prospective competitors can secure full information by addressing the board of park commissioners.

German Artificial Stone Paving.

An artificial stone for paving purposes, was treated in a report by U. S. Consul H. W. Harris, at Nuremberg, recently. He says:

The stone is composed of crushed basalt or other similar rocks collected in part as refuse from quarries and mixed with a small percentage of cement. The mixture is subjected to heavy hydraulic pressure and formed into blocks of convenient size for paving. These blocks are then subjected to process of burning under high temperature in specially prepared furnaces, which process continues for about 12 days. The blocks are then permitted to cool as slowly as possible. This process of manufacture, resembling somewhat remotely nature's process in the formation of volcanic rocks, furnishes the name Vulkanol.

The blocks are of a brown chocolate color, and show on a broken edge a similar color intermixed with white grains and small fragments of feldspar. The blocks are tough in structure and, it is claimed, withstand all the ordinary tests as to crushing, frost, disintegration, and so forth, that they do not become smooth or slippery by use, and are as durable as natural granite. For much traveled streets, where heavily loaded wagons are in use, a six-inch concrete foundation is recommended by the manufacturers, while for lighter traffic a foundation of macadam is regarded ample. On a concrete foundation stones six centimetres (2.36 inches) in thickness are said to be ordinarily sufficient. On a macadam foundation stones of eight centimetres (3.15 inches) in thickness are preferable.

The manufacturers claim that by reason of its hardness and close fitting joints pavements of this material are comparatively free from dust; that filth cannot penetrate to the ground below; that the pavement can be readily cleaned with a hose, and on sanitary grounds is unsurpassed by any other form of pavement. The claim is also made that the pavement can be readily fitted to street car tracks, is well adapted for automobile roadways, and is comparatively noiseless. Thinner tiles of the material are made for sidewalk purposes, the surface of those being grooved where required on grades or for other reason.

The pavement has been tried with satisfactory results, as it is claimed, on short stretches of street, or on driveways, courtyards, etc., in Wurzburg, Munich, Bremen, Cologne, Bamberg and elsewhere.

The cost of street paving with this material is said to be less in this part of Germany than where granite blocks are used, and slightly more than the first cost when asphalt is used. It is claimed, however, that asphalt paving is more expensive than Vulkanol, by reason of fewer repairs required on the latter.

A Mammoth Stone Crusher.

A mammoth stone crusher, said to be the largest in the world, which is now in operation in South Pittsburg, Tenn., at a cement plant, is able to take rocks as large as 3 by 5 by 10 feet and crush them to a 6-inch size at the rate of 800 tons per hour—a remarkable feat when it is considered that the rock so reduced is hard and tough limestone. The machine is about 19 feet high, and the mouth of the hopper is 20 feet in diameter, with fairly steep sides, so as to facilitate the feeding of the stone from all sides by gravity. The crusher belongs to the "suspended" type of machine, the gyratory shaft on which the head is mounted being suspended from a spider at the upper end of the crusher. The shaft is supported in the hub of the spider in such a manner that it may oscillate slightly. The lower end of the shaft is formed with an eccentric bushing, which engages an eccentric ring. The latter carries a bevel gear, which meshes with a bevel pinion on the driving shaft. As the driving shaft is rotated, the eccentric serves to impart a gyratory motion to the shaft. The crushing head, which is supported on this shaft, is conical in form, with a corrugated surface. The gyratory motion of the head produces a powerful crushing motion. The eccentric of the machine operates in a reservoir of oil, to prevent friction and reduce the wear of parts to a minimum. The top shell of the crusher was made in two pieces, in order to bring it within limits of railroad transportation.

MUNICIPAL AND TECHNICAL LITERATURE

Special Assessment Forms—Technical Index—Publishers' Consolidation—New Publications

Forms for Special Assessments.

The National Brick Manufacturers' Association has issued a book of forms for special assessments, covering municipal paving proceedings, and illustrating every step that must be taken in improvements made under the new paving law in Indiana. All the steps provided by the new law have been interpreted and placed in intelligible form by Crate D. Bowen, city attorney of Indianapolis, who has been more than three months in compiling the book.

The Technical Index in America.

The *Technical Index*, a comprehensive record of current technical literature, published in Belgium, announces that hereafter it will be represented in the United States by the Geo. H. Gibson Co., Tribune Bldg., New York City. The *Technical Index* appears monthly and gives a systematic descriptive record of all original articles appearing in over 200 engineering and technical journals and reviews, also indexing the proceedings of technical societies and technical books issued in all countries. The method of indexing covers the name of the author, the title of the article in full, an explanatory note stating the contents of the article, the name and date of the publication in which the article appeared and the length of the article. Two editions are printed, one upon both sides of the paper and one upon one side only for card index purposes and for further convenience all items are arranged according to the Dewey decimal system. Clippings or copies of articles, also books, are supplied by the publishers of the *Index*, the price being indicated in each case. It is stated that over 1,000 original articles are indexed each month, covering all lines of engineering and technology. The American agents offer to send free sample copies upon request and will also receive orders and subscriptions.

Consolidation of Book Publishing Firms.

The book departments of the McGraw Publishing Company and the Hill Publishing Company have consolidated under the corporate name of the McGraw-Hill Book

Company, with offices after July 1, at 239 West Thirty-ninth street, New York. This consolidation brings together two of the most active publishers of technical books in the country. The new company takes over the book departments of both houses with a list of about 250 titles, both industrial and college text books, covering all lines of engineering. It will continue as well the retail, importing and jobbing business of the two houses.

The officers of the new company are: President, John A. Hill; vice president, James H. McGraw; treasurer, Edward Caldwell; secretary, Martin M. Foss.

Mr. Hill is head of the Hill Publishing Company, which controls the *American Machinist, The Engineering and Mining Journal,* and *Power and the Engineer.* Mr. McGraw is head of the McGraw Publishing Company, which issues *The Electrical World, Electric Railway Journal* and *The Engineering Record.* Mr. Caldwell has been manager of the McGraw book department for several years, and Mr. Foss manager of the Hill book department.

The Directory of American Cement Industries.

The fifth edition of the Directory of American Cement Industries has just been issued and has been thoroughly revised and enlarged. In fact, the revision of the lists of names of persons in the various parts of the cement field is so complete that they are new lists entirely.

An editorial gives some of the facts taken from the introduction to the book. The list of manufacturers of cement contains the names of all companies making or proposing to make any kind of hydraulic cement, with the names of officers and employes, and full information about materials used, kinds and brands of cement, capacities, shipping facilities, sales departments, etc. The following lists arrange alphabetically the names of sales agents, brands, all officers of companies (a very convenient list), and one list gives a geographical arrangement of the cement companies. There are also lists of English and Japanese makers of cement. Quite an interesting list is that of cement company names not now in use, which gives those which have dropped out of use since the fourth edition was issued, and the reasons therefor.

This department of the manufacturers of cement occupies 187 pages.

The list of dealers in cement fills 120 pages, that of contractors about 180 pages, the manufacturers of cement products, including artificial stone, reinforced concrete and other similar products, fill 36 pages, the engineers and architects 75 pages, the laboratories and engineers analyzing and testing cement, designing cement plants, etc., 3 pages, and the makers of and dealers in machinery and supplies for cement plants and for cement users 56 pages.

Full new lists are given in the latter department of makers of block machines and molds, including posts, pipe and all factory made concrete articles, dealers in broken stone, gravel and sand, concrete mixer makers, mortar color dealers, reinforcement for concrete, tools for cement workers, and water-proofing, in addition to the numerous full lists of those supplying the many other kinds of machinery and supplies required in the cement trades.

The lists of makers and large dealers in plaster and in lime, which were in the earlier editions of the book, have been again included, the lists being entirely new and brought down to date.

The Directory is larger than ever, 682 pages, and is the only publication giving full information about the whole cement field. There is no other book giving more than one-twentieth of the data which it presents and none which is as complete in any particular list.

The price of the book is $5, and it is published by MUNICIPAL ENGINEERING COMPANY, Indianapolis and New York.

New Publications.

Specifications for Street Roadway Pavements. By S. Whinery, M. Am. Soc. C. E. 56 pp. Paper, 50 cents, net. Engineering News Publishing Co., New York.

Attention is again called to this booklet because it is prepared by an expert in paving design and construction and gives a very satisfactory set of general specifications for street pavements. The specifications covering the general features of paving contracts are quite full, and cover all the points likely to arise in the interpretation and supervision of a contract, except those arising from strictly local conditions. The specifications for foundations include Portland and natural cement concrete, old paving stone and broken stone. The specifications for wearing surfaces include asphalt, in the laying of which the author has had many years' experience, foreign rock asphalt and block asphalt. Granite block specifications are given, also those for brick pavements, following closely the standard specifications of the National Brick Manufacturers' Association. Specifications for treated wooden block pavements are also given, following the average specification. They are the least satisfactory of any of the specifications given. Other bituminous pavements than asphalt are not included, although bituminous concrete is mentioned and the author is the inventor of one form of such pavement.

The city engineer and the contractor will find the booklet very convenient and he will not go far wrong if he follows it to the letter.

Hydraulics. Vol. I. Hydraulic Machinery. By S. Dunkerley. 343 pp. Cloth, 10s. 6d., net. Longmans, Green & Co., London and New York.

Professor Dunkerley has prepared a

book on hydraulics on the basis of notes for lectures given at the Royal Naval College, Greenwich, and the examples and problems are largely devoted to this service. The chapters treat of the flow of a perfect fluid, fluid friction, hydraulic pressure machines, reciprocating pumps, turbines and hydraulic rams, centrifugal pumps, and a description of Professor Osborne Reynolds's researches on the flow of water in confined channels and on lubricants.

Several books on hydraulics have appeared in England in recent years, none of which is exhaustive and some of which have not been correct in principle. Fortunately, aside from some errors, doubtless typographical, this book can be more safely followed, so far as it goes. The practice described is largely English and is assumed in the book to be English, when really some of it was introduced in England by the English branches of American and other foreign firms. The treatment is almost entirely from the theoretical standpoint, but the examples given are in general good practice. The book must be supplemented by one giving more practical applications of the theories or by actual practice.

ORGANIZATIONS AND INDIVIDUALS

American Society Testing Materials—Road Congress—American Society Civil Engineers—Chicago Cement Conventions—Technical Meetings—Personal Notes

Convention of American Society for Testing Materials.

The twelfth annual convention of the American Society for Testing Materials was held at Atlantic City, N. J., from June 29 to July 3, inclusive. The practice of holding simultaneous sessions of different sections, which obtained about four years ago, owing to the fact that the programs became so large as to make it impossible to crowd the meeting into three days without some such plan, was changed. That plan caused dissatisfaction on the part of those who desired to attend two sections, for instance, so this year only single sessions were held, nine in all, extending from Tuesday noon, June 28, to Saturday noon, July 3. This left three open periods.

The business proceedings of the meeting were of small import, but the technical proceedings were of great importance.

Prof. G. F. Swain, chairman of the committee on standard specifications for cement, reported two changes in the present wording of these specifications. The clause relating to specific gravity was changed to read:

"The specific gravity of cement shall not be less than 3.10. Should the tests of cement as received fall below this requirement, a second test may be made upon a sample ignited at a low red heat. The loss in weight of the ignited cement shall not exceed 4 per cent."

The minimum requirements for tensile strength for briquettes 1 inch square were changed to the following, from which figures there must be no retrogression within the specified period:

	Natural cement.		Portland cement.	
Age.	Neat.	1:3 mortar.	Neat.	1:3 mortar.
24 hours in moist air.	75	...	175	...
1 day in moist air, 6 days in water	150	50	500	200
1 day in moist air, 27 days in water	250	125	600	275

The mortar tests are to be made with standard Ottawa sand. For some time great difficulty was experienced in securing this sand, but recently a special company has been organized by those interested in cement testing to prepare and market the material. This company is the Ottawa Silica Company, of Ottawa, Ill.

In a paper on the practical use to be made of cement testing, R. K. Meade suggested that clauses should be inserted in specifications for cement, giving a bonus for deliveries which exceeded in quality that called for by the specifications, just as a bonus payment is sometimes made for coal exceeding in quality that adopted as the specified coal under a contract. He referred particularly to a clause giving a bonus for fine grinding, which had been inserted in a Kansas City specification. The paper was discussed at some length. It was pointed out that fine grinding was by no means a proper basis for such a premium. The opinion was expressed that

the clause in the Kansas City specification was bad practice, increasing cost of cement without corresponding benefit.

Prof. F. E. Turneaure presented for the committee on reinforced concrete a manual of suggested practice which has been adopted by four societies and it was ordered printed.

R. A. Cummings described some experiments on bearing value of rods in concrete which are in progress. These tests are being made by Mr. E. D. McCready, of the Lehigh Valley Testing Laboratory at Allentown. The paper aroused considerable discussion as to whether the tests indicate shear or bearing value, but Prof. A. N. Talbot pointed out that, irrespective of this point, they showed the bearing strength of bars imbedded in concrete, which was the author's object in making the investigation.

Prof. M. O. Withey prepared for the meeting a paper on the tests of plain and reinforced concrete columns made recently at the University of Wisconsin. The paper was discussed at some length by Prof. Talbot, who described briefly his recent investigations at the University of Illinois, which confirmed in most details the work explained by Professor Withey.

A paper was presented by Prof. H. C. Berry, explaining further tests on reinforced concrete beams under oft-repeated loading, conducted at the laboratory of the University of Pennsylvania. The conclusions drawn from the results confirm those formerly stated. Professor Berry also read a paper on tests of the bond of steel rods imbedded in concrete by three methods. This paper brought out clearly the fact that there was a material difference between the bond of bars in concrete beams and those in blocks made for testing purposes.

A paper by L. S. Moisseiff on concrete reinforced by nails aroused considerable interest. The concrete in question was used for filling the large steel castings forming the base of the Williamsburg Bridge. It was desirable to obtain a concrete of the greatest maximum compressive resistance, irrespective of cost, a result which was obtained by filling the concrete with ordinary wire nails. The paper brought out considerable discussion, in the course of which Prof. I. H. Woolson stated that he had made a number of experiments with concrete reinforced with ordinary jackstones. Cubes of concrete reinforced in this way had shown an extraordinary strength, and when crushed the cracking was accompanied by loud reports, which were assumed to be caused by the breaking of the cast iron of the jackstones. He had made other tests of concrete reinforced by steel punchings, but as the latter did not have the bond of the jackstones, the tests were not of importance. In his opinion, concrete might be reinforced by punchings or pieces of twisted wire of such a shape that the steel would have a strong bond with the concrete.

A paper was presented by Mr. Prevost Hubbard on the effect of free carbon in tars from the standpoint of road treatment. The author concluded that no reliable comparative data as to the actual service results obtained by the use of high and low carbon tars in road work are at present available. Many other factors besides the free carbon content have to be considered in forming a correct opinion of the relative value of two tars. His own observations are that in the treatment of old road surfaces a low carbon tar is to be greatly preferred to a high carbon tar. Several of the engineers present stated that they had obtained better results with high carbon than low carbon tars in such work.

A progress report of the committee on standard specifications for sewer pipe was presented by Dr. Rudolph Hering, chairman. The subjects to be considered were divided into three classes:

1. The demands made upon the sewer pipes. Under this heading all demands relating both to the materials of vitrified clay and cement and to the usual methods of construction, as well as those relating to the several uses of sewers, should be stated.

2. The practical tests which will secure materials and manufacture that will answer these demands. Under this heading should be set forth the qualities of the materials, the efficiency of the manufacture and the actual strength and durability of the different materials and combinations of materials used in different parts of the country, and the serviceability both of the completed pipe line and of its elements.

3. Specifications for the work of laying pipe lines under different conditions. Under this heading should be given conclusions regarding transportation and delivery of the pipe to the site of the work, the preparation of the trench and foundations, the laying and joining of the pipes and the refilling of the trenches, so that the pipes manufactured from the available materials and laid according to the above conclusions will furnish in every way a satisfactory and reliable structure.

The demands upon sewer pipes are:

(a) As to strength. This includes resistance against rupture, homogeneity of the material, the age of cement pipe before put into use, and the vitrification of the clay pipes. It includes also the necessary data for the thickness of shell, the importance of fire cracks in vitrified pipes and hair cracks in cement pipes. The proper requirements should be stated for the strength necessary to resist crushing, bursting and impact, under various practical conditions.

(b) As to durability. This includes resistance to wear and tear. There should be given the required resistance against abrasion by sand or gravel at high velocities in glazed and unglazed pipes, the density or specific gravity of the material

with relation to its porosity and capillary absorption of moisture. There should be considered the corrosion of glazed and unglazed vitrified clay and Portland cement pipes by acids, alkalies, steam, frost and gases. An inquiry should be made into the merits of protective coatings or linings for Portland cement pipes to resist the usual chemical actions of certain ingredients of sewage.

(c) As to serviceability. This relates to the efficiency of the pipes to perform the best service. Under this heading should be considered the question of smoothness, the glazing of vitrified pipes, and blisters; the best sectional form for various purposes, and the warping of pipes, including the permissible deviation from true, straight pipes and regular curves or specials. The best lengths of the individual straight pipes and specials should be determined. The ends of pipes with reference to making the best joints should receive most careful study to determine the best practice for different conditions, including hub and spigot, butt and collar, and beveled joints. All specials, such as branches, spurs, curves, etc., should receive attention with reference to recommendations as to their size and form.

A testing machine which obtains its pressure by a hydraulic jack, and weighs this pressure in a novel manner, was furnished to Rensselaer Polytechnic Institute by T. Olsen & Co. recently. This is of 600 tons capacity. A closely similar machine of 5,000 tons capacity for the Geological Survey is nearly completed. The 600-ton machine was described by T. Olsen at the meeting. The pressure of the water in the press is weighed by a set of ordinary weighing levers which act on a flexible diaphragm in the cylinder, the area of the diaphragm being just one-twenty-fifth that of the cylinder cross-section. The makers claim for the weighing system an accuracy exceeding one-third of one per cent. The machine was calibrated by weighted levers for low loads, and on extending this upward and checking against the Illinois 300-ton lever machine a very exact coincidence was obtained. The machine is so sensitive as to respond to the pressure of the hand when balanced under load.

Mr. Olsen read a second paper on "A Machine of New Design for Hardness Test." This machine has compound levers 1-100, to which a constant weight is applied after the specimen is in the machine. These levers press a ⅝-inch steel ball upon the specimen tested, and at the same time a multiplying pointer indicates the indentation produced by the ball.

H. Abraham described two carefully designed instruments for tests on bituminous materials. One of them, a needle instrument for testing hardness or penetrability, represents a distinctly new idea in this direction, as the needles used, which have a mushroom-shaped flat head, are pressed into the material at a definite rate of penetration (1 cm. in 1 min.), to a definite depth (1 cm.), and the maximum pressure required for this is recorded automatically. The square root of this pressure is taken to designate the hardness numerically. The number 100 represents a load of 10,000 grams on the smallest needle used, 0.01 sq. cm. in area, and as this represents a pressure of over 14,000 pounds per square inch, rather hard substances can be represented on this scale of hardness. This instrument has been called the consistometer.

Papers were read by title only, describing other instruments for testing oils or bitumens, by A. W. Dow, New York City, on "A Viscosimeter for Heavy Road Oils;" by F. P. Smith, of New York City, "A Machine for Testing the Ductility of Bituminous Paving Cements;" by C. N. Forrest, of Maurer, N. J., "A Further Development of the Penetrometer as Used in the Determination of the Consistency of Semi-Solid Bitumens."

Papers on oils and bitumens were submitted, most of them not being read, as follows:

"The Effect of Free Carbon in Tars from the Standpoint of Road Treatment," by P. Hubbard, Office of Public Roads, Washington, D. C.

"Methods for the Examination of Bituminous Materials in Use in Highway Construction," by C. Richardson and C. N. Forrest, Maurer, N. J.

"Bituminous Materials for Use in and on Road Surfaces, and Means of Determining Their Character," by C. Richardson.

"Notes on Testing Turbine Oil," by R. Job, Philadelphia, Pa.

"Conditions Affecting the Determination of Carbenes in Bitumens of Carbon Tetrachloride," by C. N. Forrest and D. B. W. Alexander, Maurer, N. J.

Many other papers and committee reports were read in full or by title.

Road Congress at Seattle Exposition.

The first American Congress of Road Builders was held in the Washington Good Road building on the Alaska-Yukon-Pacific Exposition grounds, at Seattle, Washington, July 4, 5, 6, 7 and 8. The Congress was initiated and carried out by Samuel Hill, of Seattle, and it was successful in every respect.

The papers presented were as follows: "The History of Road Building in the United States," by E. L. Powers, of New York City; "Wood Block Pavements," by Andrew Rinker, of Minneapolis, Minn.; "Earth, Sand-Clay and Gravel Roads," M. O. Eldredge, representing the Office of Public Roads of the U. S. Department of Agriculture at the A.-Y.-P. Exposition; "Bridges: Steel, Stone and Concrete," Charles Evan Fowler, of Seattle; "Portland Cement: Its Manufacture and Use;" "Characteristics of Stone Suited for Use

as Macadam or for Paving Blocks," Prof. Henry Landes, of the Washington State University; "Successful Macadam Roadways, with Clay and Stone Binder," A. W. Campbell, Toronto, road commissioner of Ontario; "Why and How Cities Are Built," R. H. Thomson, city engineer of Seattle; "The Farmer and the Road," F. N. Godfrey, Olean, N. Y.; "Some Features of Macadam Construction," A. N. Johnson, engineer of the Illinois Highway Commission; "A Proposition for a New Way of Financing the Construction and Maintenance of Roads," R. M. Brereton, of Oregon; "Vitrified Brick," George W. Kummer, of Seattle; "Asphalt Macadam Roadway," Clifford Richardson; "Worth of Roadways and Their Subdivisions," W. S. Keller, of Tennessee.

A paper was read by Mr. Hooley, of England, on "Tar-Mac Roads," a form of construction identified with his name which has been successfully used in Great Britain for the last ten years. He stated that the tar-mac road is composed of blast-furnace slag and coal-gas tar, to which rosin and Portland cement have been added in certain proportions and by methods which are covered by patents in the United States and abroad. The slag, as it comes from the furnace, is crushed while warm and before cooling below 160 degrees F. is coated with the tar and shipped in this form to the point where it is to be used, in three sizes, 2¼, 1½ and ⅝ in. A layer of the latter is laid on the supporting surface, which may be that of an old, worn-out road. Upon this sufficient 2¼-in. material is spread to result in a thickness of 2 in. when rolled and compacted. On this, again, a layer of ⅝-in. stone is placed and rolled, followed by 1½-in. stone sufficient to make, with the preceding course, a thickness, after compression, of 3 in. A final application of ⅝-in. stone in a thin layer which is well rolled into the coarser stone completes the road. The crown recommended is 1 in 50. The life of the road has been shown to be from seven to ten years.

A committee of nine was named to consider and report upon a movement for a permanent national organization for perpetuating the Congress. This committee consists of Samuel Hill and R. H. Thomson, of Seattle; E. L. Powers, E. N. Godfrey and Clifford Richardson, of New York; A. W. Campbell, of Toronto; J. W. Lawrence, of Colfax, Wash., and A. N. Johnson, of Illinois.

Convention of American Society of Civil Engineers.

The forty-first annual convention of the American Society of Civil Engineers was held at the Mt. Washington Hotel, Bretton Woods, N. H., July 6, 7, 8 and 9. The convention was opened by an address of welcome from Hon. H. B. Quimby, Governor of New Hampshire, and the response for the society was made by President Onward Bates, who then delivered the annual address.

Committee reports were considered and other business transacted on Wednesday evening, and topical discussions were held Thursday afternoon. One committee report, "The Status of the Metric System," gave rise to no discussion, and a written communication regarding the subject was not read. The "Report of the Special Committee on Concrete and Reinforced Concrete" was discussed at length. This report was published in the proceedings for February, 1909.

The subjects for topical discussion were as follows: "Fire Resistant Construction in Buildings," by Herbert M. Wilson; "Impurities in Sand for Concrete," by Sanford E. Thompson; "Has Experience Demonstrated That Oiling of Roads is the Most Satisfactory Process for Preventing Dust and Preserving the Road Surface?" The latter was introduced by S. Whinery, who considered that oiling is comparable only with sprinkling with water, and that emulsions of oil or deliquescent salt in water are comparable, but that it is doubtful if either is more economical or satisfactory than water alone. Broken stone roads properly sprinkled will largely escape abrasion and raveling, especially under motor traffic. Ordinarily water sprinkling is not properly executed, and very little useful or reliable data of it is recorded, many features of the frequency, amount and conditions of water sprinkling being usually neglected. On the other hand, full data have been preserved of the cost and operations of oiling. Sprinkling with water alone will undoubtedly prevent dust and raveling, and the most serious objection to it is that when improperly sprinkled the roads may be slippery and muddy. Neither the application of the water, the presence of the sprinkling plant, or any requirement of the sprinkled surface interrupts the traffic. He stated that "oiling is equally efficient if the entire surface of the road is oiled, but frequently the oiling is omitted on the edges and only the center portion is oiled. As it is considered that oiling should be done only when the road surface is cleaned, dry and properly prepared, the oiling is usually deferred until rather late in the season, and the road is then closed to traffic for several days. Before the oil is absorbed it destroys paint and varnish on vehicles, stains the clothing and adheres to the feet, causing injury to carpets and floors. Oiling does not prevent, but rather promotes, abrasion analogous to raveling."

He stated further that "the best available records indicate a cost of two cents a square yard per season for watering some macadam roads. Very often these roads are sprinkled twice a day with an excess of water, when much better results could be secured by sprinkling them more carefully three times a day with less water. Therefore, it is assumed that from

3 to 3½ cents a yard is a suitable estimate for careful and efficient sprinkling. The best practice of oiling gives a cost of 5½ to 6 cents per square yard for a single application, efficient from July to the end of the season, but not wholly disappearing before the next season. This cost of 5½ cents against 3½ cents for sprinkling gives a difference of 57 per cent., while the oiling is not 50 per cent. superior to the sprinkling, when both are equally well done. Assume the capitalized cost of oiling to be $1.00 per square yard. If this sum be added to the first cost of construction for a macadam road, the road will not require oiling.

Mr. G. S. Davison considered that while most of the oil used in New York, Philadelphia and Boston is cheaply brought from the South, the increased freight charges would make its cost almost or quite prohibitive for a large portion of the western country.

The time and place of holding the next convention was left to the board of directors. Invitations were received from a number of cities, Duluth, Minn., receiving the most votes, and the proposition to charter a large steamer on the Great Lakes and stop at the principal lake cities was favorably received. It was also pointed out an attractive trip might be planned to the Isthmus of Panama, if not for next year, for the year 1911.

Chicago Cement Conventions and Exhibits.

The dates for the third annual cement show in the Coliseum, Chicago, have been fixed for February 18-26, 1910. The show will open on the evening of February 18, and be open continuously, except Sunday, the 20th, until the evening of Saturday, February 26. Under the new dates the show will be open two days longer than that of last February.

The National Association of Cement Users will hold their sixth annual convention in Chicago on February 21-24, and the American Society of Engineering Contractors have accepted an invitation from the Cement Products Exhibition Company to hold their convention in Chicago, February 24, 25 and 26. George W. Jackson, the well-known Chicago contractor, is president of the latter society, which has some 1,500 members. The conventions of these organizations in Chicago during the cement show will insure the largest gathering of the cement interests ever held.

Technical Meetings.

The fourth international sanitary convention of American Republics will be held in San Jose, Costa Rica, December 25, 1909, to January 2, 1910.

The annual meeting of the Irrigation Congress will be held at Spokane, Wash., August 9, 10, 11, 12, 13 and 14. B. A. Fowler, sec'y., Phoenix, Ariz.

The annual convention of the League of American Municipalities will be held at Montreal, Que., August 25, 26 and 27. John MacVicar, sec'y., Des Moines, Ia.

The annual convention of the Association of Edison Illuminating Companies will be held at Briarcliff Manor, N. Y. D. L. Huntington, sec'y., Spokane, Wash.

The annual convention of the New England Water Works Association will be held at New York City. Willard Kent, sec'y., 715 Tremont Temple, Boston, Mass.

The annual convention of the International Association of Municipal Electricians will be held at Atlantic City, N. J., September 14, 15 and 16. Frank P. Foster, sec'y., Corning, N. Y.

The annual convention of the Michigan Gas Association will be held September 14, 15, 16 and 17 on board steamer sailing from Detroit, Mich. A. P. Ewing, sec'y., Gas Office Bldg., Detroit, Mich.

The annual convention of the American Society of Municipal Improvements will be held in Little Rock, Ark., November 9 to 11, 1909.

Personal Notes.

Leslie Allen has resigned as city engineer of Rennselaer, N. Y.

Edward L. Titlow has been appointed city engineer at Frederick, Md.

Albert P. Brayton, president and founder of the Pelton Water Wheel Co., died at his home in Oakland, Cal., June 25, aged 82 years.

W. S. Gearhart has been appointed highway engineer at the State Agricultural College, Manhattan, Kans., and will have charge of investigations of Kansas highways and bridge problems.

John R. Davis, former mayor of Jacksonville, Ill., died July 18, after an illness extending over two years, aged 45 years. Mr. Davis served as alderman from the Second ward and as mayor for three terms, and was one of the organizers of the Whitehall Sewer Pipe Co.

Hon. Leopold Markbreit, mayor of Cincinnati, died July 27, after an illness extending over the greater part of the nineteen months he has served as mayor. He will be succeeded in office by Vice Mayor John Galvin, who has acted in that capacity a good part of the time of Col. Markbreit's illness.

Robert E. McDonnell, of Kansas City, Mo., is making a four months' trip to Germany, France and England, for the purpose of investigating water works and sewage disposal plants with a view toward the preparation of a report relative to the contemplated improvements in the water works system in Kansas City.

Francis P. Bergen, of Williams & Bergen, San Francisco, Cal., advisory engineers of the Civic League, an organization of the property interests of that city, has returned from an extended trip in the East, where he investigated the existing high-pressure fire protection systems, as well as inspected machinery and material being manufactured there for San Francisco.

Alexander Potter, consulting and constructing engineer, 114 Liberty street, New York City, was re-elected chief engineer, June 17, at the annual meeting of the joint district comprising Newark, Irvington, South Orange, West Orange, Millburn, and Summit, N. J. The other officers re-elected were: Chairman, Francis Speir, of South Orange; treasurer, Simeon Rollinson, West Orange; secre-

tary, Arthur Tepper, Summit; counsel, Adrian Riker, Newark.

A. Bradshaw Holmes, secretary and treasurer of the Independent Pneumatic Tool Company, and the Aurora Automatic Machinery Company, of Chicago, died June 30, aged 31 years, of injuries received in a fall from the piazza of his hotel. Mr. Holmes has been secretary and treasurer of the Independent Pneumatic Tool Company since its organization, and was previously associated for a number of years with the Standard Pneumatic Tool Company and the Rand Drill Company.

MACHINERY AND TRADE

Odorless Garbage and Refuse Carts.

There is nothing about the administration of cities and towns that has attracted in late years more attention, probably, than the subject of collection and disposal, in a healthful way, of the unavoidable refuse, such as garbage, night soil, material from sewer inlets, street sweepings, ashes, etc. There is no question but that this material will accumulate, that it must be collected and removed, and that it must be done in a manner that not only will not offend the eye or the senses, but which must also, as far as possible, be thoroughly sanitary. The day of the open, leaky, offensive wooden carts or wagons, loaded with wood or metal barrels, has, we hope, gone for good. The public health demands that these collections shall be made in vehicles which will not absorb moisture, which shall be as near as possible air and water tight, easily cleaned and sightly in appearance. The contractor or collector requires that the vehicle shall be as light as consistent with the strength required to carry a full load, that it shall be low enough when at rest to be easily loaded, that it must be water tight and as near as possible air tight, easily cleaned and kept clean, strong enough for the service required, and still no unnecessary weight to overwork the horse, it must dump easily and thoroughly, it must have lids that will open and close with little exertion, the parts must be interchangeable so that the results of accidents or wear can be readily remedied, and last, but by no means least, shall be well made, and not exorbitant in price. Developed from a practical knowledge of the needs of the service after a careful study of what was already in use for the purpose, built up from a small beginning, improved in every way practicable, Geo. H. Holzbog & Co., Jeffersonville, Ind., offer vehicles meeting the requirements. The tanks are of steel, thoroughly riveted and absolutely water tight; the lids, there are two of them, one at the front and one at the rear to allow of completely filling the body, are made with deep flanges, close fitting, and when down are securely locked in place; the rear lid is operated by a spring handle on the side of the body and can be locked open at any of several positions when vehicle is being loaded or dumped. The axle is built up of five pieces, so as to encase that portion of it going through the body in a steel boiler tube, expanding at the ends, obviating the possibility of leakage at that point.

Castings are all made of steel, malleable iron, and grey iron, mostly steel and malleable iron, and they, with axle boxes, arms, etc., are all made and finished to exact patterns so that repairs can be quickly had at any time at reasonable prices, and will almost always fit without further machining.

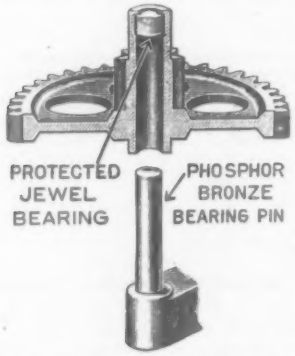
The adjustment of the body or tank at any angle is a feature, also the extremely small distance it is from the ground to top of tank when same is level. The distance from ground to top of tank on the 54 and 65 cubic foot sizes is about 4 feet 3 inches and on the 37 cubic foot size is about 4 feet 4 inches. These distances are still further reduced when tanks are run down at a slight angle to 3 feet. These tanks are nicely balanced, so that when full loaded the vehicle travels easily, without undue pressure on the horse. The dumping mechanism works so easily that a boy can readily unload when tank is completely filled. The tank being adjustable at any angle the load is completely discharged without raking out, and for convenience in washing, etc., the body can be locked in any position and the whole interior cleaned thoroughly.

Water Meter With Jewel Bearing.

The Buffalo Meter Co. have inaugurated many improvements in water meters and they are now the first to successfully apply the advantages of jewel bearings to water meter gears.

This construction reduces friction and wear among the working parts of the meter and thus increases its accuracy and durability. The accompanying illustration

shows plainly how the weight of the gears is carried on a jewel revolving on a pivot and that the jewel closes the upper end of the bearing so that no sand nor dirt can enter and cause excessive wear. The



jewels are of substantial size and shape and are parmenantly fastened in place in the gear.

Upon opening the meters at the bolted flanges each gear may be immediately lifted from its bearing. The simplicity of this design is not approached by that of

any other meter and it greatly facilitates inspection and cleaning. The entire meter is made with unusual care and precision and all parts are strong and substantial.

Complete details may be had by writing the Buffalo Meter Co., Buffalo, N. Y.

Prolonging the Life of Macadam Under Automobiles.

Automobiles were common in France some years before they became a frequent sight on American highways, and the French engineers are accordingly that much ahead of the Americans in their study of the dust problem on macadam roads. The difficulty of maintaining macadam under this new style of traffic is most acutely felt in the Bois de Boulogne in Paris. It is the custom in the French capitol to sprinkle the wooden pavements of the principal thoroughfares, such as the Rivoli and the Champs Elysees, five or six times a day. The consequence is that every automobile in Paris is obliged to use steel studded tires all the time, as it would be manifestly impossible to stop and put on tire chains or other anti-skid devices every time the vehicle approached a strip of wet pavement. The steel-studded tire on these vehicles driven at the high speed which is permitted in Paris, is probably the most destructive agent to macadam roads that could possibly be devised. Nearly all the traffic through the Bois de Boulogne consists of automobiles —the powerful low-geared little taxicab comprising a large proportion of the total.

When these automobiles, threading their way through the mazes of park traffic on a sunny afternoon, put on their brakes sharply and drag these steel studded tires along the macadam, the result can be easily imagined. Ordinary macadam would not survive a week. The park authorities impose a special tax on every automobile that passes through the gate as a sort of fine for the damage that the vehicle will cause to the roads in the park.

The maintenance of the roads has been brought down to a fine point. A considerable force of men is constantly at work in one place or another in the park keeping the roads in smooth, dustless condition.

Probably every maker of dust preventives has endeavored to secure the large market for his material which the park contract would offer, but tar is the only remedy which has found acceptance. Special apparatus for heating and distributing the tar is employed. The tar is spread over the surface of the macadam while hot. It percolates into the fine pores of the road and on cooling solidifies there, forming a matrix around the stone and holding it there so firmly that automobiles cannot tear it loose, or stir it up into dust. The wear on the road is thus, to a large extent, prevented. The roads are carefully cleaned and are rarely or never sprinkled with water, the tar treatment being a sufficient and satisfactory antidote to dust.

The acuteness of the problem in the Bois de Boulogne makes the endorsement by the authorities of the tar treatment highly significant. Road engineers all over the world have been reaching the same conclusions, and at the International Road Congress in Paris, a great proportion of the time was given over to the discussion of the best ways and means of utilizing tar, the superiority of the treatment over dust palliatives such as oils and sticky solutions of water being tacitly conceded.

The tar which is used by the French engineers is not raw or crude tar, but one which has been subjected to a certain amount of distillation and refining, so that

THE FRENCH PROCESS OF DUST PREVENTION IN AMERICA—A TARVIA APPLICATION ON A BOSTON BOULEVARD.

A TARVIATED ROAD, EVANSTON, ILL.

uniformity of results can be made reasonably certain.

In this country that particular preparation of tar is known as tarvia, and is made in three grades of different density to provide for varying conditions in which it is to be used. The densest and heaviest grade of the tarvia is known as Tarvia X, and is sufficiently thick in its consistency to fill the large voids of the one and one-half inch stone with which it can be advantageously mixed in the course of building a new road.

For resurfacing, Tarvis A is used, a lighter material, as Tarvia X is too dense to penetrate the small voids of the stone screenings; while for an old road where all voids are filled with dust, a still lighter material, called Tarvia B, is employed.

The use of tarvia in any of the three ways effects so large a reduction in the cost of proper maintenance as to more than pay for itself. If tarvia is used, a dustless road accordingly is less expensive than a dusty one.

Meter Boxes Under Cement Sidewalks.

When it is necessary to lay a cement or other concrete sidewalk over a meter box, the apparatus to be used and the process used are described as follows:

The temporary cover (Fig. 1) is placed on the meter box body after it has been brought to proper grade. The sidewalk contractor finishes the walk up to and around the temporary cover, which is left in place until the water department desires to place regular cover and lid. The temporary cover is made heavy enough to withstand all traffic and as the top is level with the surface it can be left in place indefinitely. To remove the temporary cover, the eyelet, with ring attached, is screwed into threaded hole in the center and a bar of 2-inch pipe or round iron is passed through the ring, a brick or wooden block is placed on the side for a fulcrum and the cover is lifted straight up. The edges of the casting may be tapped lightly with a hammer to loosen while lifting.

The concrete block over the regular Clark meter box cover and lid, is molded as follows: The cover is placed in the ring form (Fig. 2); concrete is filled in

Fig. 1.

Fig. 2.

around it and allowed to stand until thoroughly set; then the cover with concrete block is removed, another cover placed and the process continued as before. With one ring form there can be made up any quantity of these concrete blocks. These forms are all made true to pattern, thereby insuring perfect uniformity and fit. By this method of setting there is a systematic installation with all the advantages of the large box body and the small opening of the lid, with the secure and quickly operated locking device of the Clark meter box. H. W. Clark Co., 115 S. 17th street, Mattoon, Ill., will give full information as to meter boxes and settings.

More Municipal Asphalt Plants.

The Board of Public Works of Kansas City, Mo., has awarded the Warren Asphalt Paving Co. the contract for the municipal asphalt plant, on which they recently received bids. This plant, while not the largest as regards capacity, will be undoubtedly the most complete municipal asphalt plant in this country. Elaborate provisions have been made for handling cars of sand and stone, and large steel storage bins will be provided, from which the material may be handled to the dryers automatically. It is hoped that the plant will be ready for operation the latter part of September.

The same company was also recently awarded the contract for the 2,000 square yard municipal plant for the city of Montreal, and this has just been completed and turned over to the city. On account of the difficulties which the city had with the asphalt companies, they determined, this spring, to do all their asphalt paving themselves, and the contract for the plant was placed on a rush order, and the contract was completed three weeks ahead of the time limit, a valuable consideration on account of the short season in which they have to operate.

Trade Publications.

The Union Sand and aMterial Co., Liggett Bldg., St. Louis, Mo., issues a handsomely illustrated booklet about the Red Ring brand of Portland cement, made at the St. Louis Portland Cement Works. This company also manufactures the K. C. brand of Portland cement, made and sold at Kansas City, Mo.

Bulletin 18A of the Jeffrey Mfg. Co., Columbus, O., is devoted to the Jeffrey air power coal cutter.

Trade Notes.

ASPHALT.

St. Joseph, Mo.—When the ordinance authorizing the board of public works to purchase an asphalt plant came up for final reading, July 5, two members of the finance committee refused to sign a favorable report.

Cheyenne, Wyo.—Large quantities of asphaltum have been found in the Shoshone Indian reservation.

BRICK.

Seguin, Tex.—The Seguin Vitrified Paving & Face Brick Co. has been incorporated by O. G. Pearson, H. M. Wurzbach, C. E. Tips and R. L. Wuppermann. The company will take over the plant of the Lone Star Brick Co., of this city.

Bellingham, Wash.—A. von Ptesentin is organizing a company here for the manufacture of paving brick.

Mitchell, Ind.—Experts pronounce the

shale used in the manufacture of cement at this place to be of the best quality in the United States. Experiments show it to be well adapted to the manufacture of both building and vitrified brick. The shale is mined at Brownstown.

Brownsville, Tex.—A company has been formed here for the manufacture of brick, drain tile and building blocks, by Judge Noah Allen, H. H. Banker, E. W. Van Antwerp and G. D. Fairbanks. The plant is to be located on a tract of land they own in West Brownsville.

CEMENT.

Ragland, Ala.—The Atlantic & Gulf Portland Cement Co. expect their plant to be in operation soon.

Chelsea, Mich.—A receiver has been asked for the Millen Portland Cement Co. Liabilities, $200,000; assets, $150,000.

Phillipsburg, N. J.—The Lily White Cement Co. has been incorporated to manufacture Portland cement, lime, limestone, clays, plaster, etc., by W. Elwood Snyder, Reuben F. Messinger and Thomas D. Danner.

Portland, Ore.—The Portland Cement Securities Co. has been incorporated by Alex. Nibley, Aman Moore and J. N. Teal.

Toronto, Ont.—The Maple Leaf Portland Cement Co. has been incorporated by H. Riley, J. E. Riley and E. C. Ironside, of this city.

Louisiana, Mo.—The Sterling Portland Cement Co., of Delaware, has been incorporated to do business in this city. J. R. Patterson, of this city, is president.

Denver, Colo.—The Denver & Northwestern Portland Cement Co. has been incorporated here and will erect a cement plant at Colden. W. S. Campbell is president; J. B. Church, vice president; F. B. Davis, secretary; G. N. Robinson, treasurer, and H. Fleck, chemist.

The Sandusky Portland Cement Co., of Sandusky, O., have supplied their waterproof compound for the following important work: Harwood electric power plant, Harwood, Pa.; Van Heynigen residence, Mobile, Ala.; Napa State Hospital, Napa, Cal.; State Normal School, San Jose, Cal.; Point Building, Cleveland, O. Their Medusa white Portland cement has also been used on the following work: University building, Evanston, Ill.; First National Bank building, San Francisco, Cal.; Whitney building, San Francisco, Cal.; High School, Everett, Wash.; specified by the following architects in England: James Hartley and Runton & Barry. For imitation terra cotta trimmings on Tremo Hotel, Spokane, Wash. For exterior cement finish, dormitory for Pomona College, Claremont, Cal.

CONCRETE PRODUCTS.

Newark, N. J.—The American Siegwart Beam Co. has been incorporated to manufacture reinforced concrete beams, by C. H. McMahon, S. Frazier and others.

Wilson, N. C.—The Contentnea Concrete Co. has been incorporated by Thos. Felton, Sr.; M. J., T. R. and J. W. Felton.

New York City.—The Empire Construction Co., 25 W. 42nd st., has been organized to engage in the concrete and cement paving business.

Philadelphia, Pa.—The Drummond Concrete Sepulchre Co. has been incorporated by W. J. Drummond, J. F. Simpson, J. J. Simpson, A. J. Golden and J. B. Mickle.

Grand Rapids, Mich.—The Carey Concrete Co. has been organized to manufacture concrete, brick, etc., by W. H. Carey, F. J. Wood, R. L. Nash and associates.

Dublin, Ind.—The Dublin Cement Tile and Novelty Works has been incorporated by Mac Fricker, Charles M. Evans and Charles McKee.

PURCHASE OF MACHINERY.

Wakefield, R. I.—Special.—L. N. Oatley advises us that he is in the market for a cement block machine and mixer.

Beaufort, S. C.—Special.—R. R. Legare is in the market for one road roller, the cost not to exceed $2,800.

North Collins, N. Y.—Special.—C. A. Hager advises us that he is in the market for a brick machine.

Oakville, Me.—Special.—Casper Harmann advises us that he desires to purchase a block machine.

Oil City, Pa.—Special.—I. N. Hinderleiter, 5 Hasson-st., advises us that he is in the market for 6 wheel scrapers, 6 slip scrapers and an 8-ton motor traction engine and roller combined.

San Antonio, Tex.—Special.—C. T. Fincham, 324 Moore Bldg., is in the market for rock crushing machinery.

Muskogee, Okla.—Special.—J. A. Handy, supt., P. O. Box 12, desires prices on a 15-ton Erie and an 8-ton Iroquois steam road roller.

McAlester, Okla.—Special.—John W. Rooks, 603 So. A-st., advises us that he is in the market for a concrete mixer.

Denver, Pa.—Special.—Morris Roppold is in the market for a concrete mixer and a block machine.

Olean, N. Y.—The taxpayers voted to issue bonds for the purchase of a steam road roller.

Abingdon, Va.—Special.—The Abingdon Construction Co. advises us that it is in the market for one good second-hand rock crusher.

Webster City, Ia.—Special.—G. C. Mills is in the market for an almost new second-hand No. 1 Smith mixer.

Lebanon, Ky.—Special.—J. P. Rickets advises us that he desires to purchase a brick machine and a block and tile machine.

Oakville, Mo.—Special.—Casper Harmann advises us that he is in the market for white cement.

North Collins, N. Y.—Special.—C. A. Hager advises us that he is in the market for Y. P. and W. P. lumber.

Shelbyville, Ill.—Special.—R. D. Fleming, N. 4th and Charles sts., desires to know the price of cement per barrel in car lots.

Scranton, Pa.—Special.—Wm. R. Kane, care MacDonald Constr. Co., is in the market for crushed rock and sand on the C. R. R. of N. J.

LIGHT, HEAT AND POWER.

Dallas, Tex.—The Lignite Gas Power Co. has been incorporated by E. H. R. Green, J. H. McDonough and W. T. Irvin.

MISCELLANEOUS.

Chicago, Ill.—Ewen, Shankland & Schwab have been incorporated to engage in an engineering business, by W. E. Carr, William N. Sturgis and F. Find.

Memphis, Tenn.—The Memphis Sanitary Reduction Co. has been incorporated and will establish a plant for manufacturing soap and fertilizer from refuse and garbage. The plant is being constructed of concrete and corrugated iron, and will be equipped with four reduction tanks.

Syracuse, N. Y.—The Williams Bridge Co. has been incorporated to manufacture bridges and structural work, etc., by E. E. Williams, Syracuse; F. J. Tanner, Groton; J. B. French, Jamaica.

SEWER PIPE.

Buffalo, N. Y.—The Bray & Lukens Co. has been incorporated to manufacture sewer pipe, flue linings, wall coping, fire brick, cement and builders' supplies, by Wm. F. Bray, Buffalo; J. Parry Lukens, Philadelphia; Wallace Thayer, Buffalo.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Washington, D. C.—Engineer Commissioner Judson says the average condition of the asphalt pavements in this city is growing worse each year. He attributes this to a lack of sufficient provision of funds, and Congress will be asked next winter to make lower appropriations for street paving in the future.

CONTEMPLATED WORK.

Lebanon, Ill.—Paving is contemplated.

Manitowoc, Wis.—Paving is contemplated.

Hastings, Neb.—Council has been asked to pave 3rd st.

Lincoln, Ill.—Kickapoo st. is to be paved with asphalt.

Gary, Ind.—Plans are being prepared for paving Adams st. A. R. Milton, cy. engr.

Mexia, Tex.—Voted to issue bonds for street improvements and cement sidewalks.

Carmi, Ill.—Plans are being prepared for street paving here. Bd. local impvts.

Elizabethton, Tenn.—Paving is contemplated for the principal street of this town.

Waxahachie, Tex.—Will vote Aug. 7 on the issue of bonds for constructing good roads.

Bryan, O.—Ordinances have been adopted providing for paving and macadamizing 10 streets.

Oconto, Wis.—Creosoted wood block or vitrified brick paving is contemplated for Collins st.

Oskaloosa, Ia.—Council is considering the question of constructing considerable paving.

Bay City, Tex.—Voted to issue bonds for constructing street improvements. John Sutherland, mayor.

Tiffin, O.—C. J. Peters, cy. engr., has been directed to prepare plans for paving Hall st.

Macomb, Ill.—About 1-mi. of brick paving and sandstone curb is contemplated. J. M. Keefer, mayor.

Shenandoah, Ia.—The property owners in Blossom st. and Lowell ave. have petitioned for brick paving.

Denver, Colo.—The bd. of pub. wks. has decided to expend $75,000 for street improvements in East Denver.

Trenton, N. J.—Will vote Aug. 3 on the issue of bonds for paving and graveling the streets of this city.

Dover, Del.—Special.—This city is about to let a contract for brick, sheet asphalt and bitulithic paving.

Grand Junction, Ia.—Council contemplates the construction of premanent sidewalks and gutters in several streets.

Auburn, N. Y.—The city engineer has been directed to prepare plans and specifications for paving Hoopers ave. with asphalt.

Washington, Ia.—A petition has been submitted to council asking that S. Iowa ave. and E. Main and E. Washington sts. be paved.

Newton, Ill.—Plans are being prepared for constructing 2-mis. of vitrified brick paving and combined curb and gutter. Bd. local impvts.

Clinton, Ia.—Special.—R. S. Hart, cy. engr., says the city council contemplates paving 1 block of 3rd ave. with creosoted wood blocks.

Carlisle, Pa.—Special.—C. A. Bingham, borough mgr., says 1 block of vitrified brick and 3 blocks of asphaltic macadam paving is contemplated.

Lafayette, Ind.—Objections will be heard Aug. 4 on the proposed construction of cement sidewalks in Elizabeth st. Edgar H. Andress, Jr., clk. B. P. W.

Springfield, Ill.—Plans are being prepared and bids will be asked about Aug. 15 for paving Carpenter st. and Logan ave. with vitrified brick. F. H. Hamilton, cy. engr.

Nokomis, Ill.—The construction of 40,000 sq. yds. of vitrified brick paving, with concrete curb and gutter, is contemplated. Joseph Weinstein, chm. bd. local impvts.

Hutchinson, Kas.—Special.—G. L. McLane, cy. engr., says about 40,000 sq. yds. of paving will be constructed soon, under open specifications, and about 5-mis. of concrete curb is contemplated.

Orange, Va.—The Madison district of Orange co. voted to issue bonds to complete the macadam road between Gordonsville and Orange, and construct several miles of roads into the two cities.

Indianapolis, Ind.—The property owners in Kentucky ave. are urging the adoption of resolutions providing for the paving of that street between the White river bridge and Howard st., and constructing cement sidewalks.

Jonesboro, Ark.—It is estimated that the proposed paving will cost $76,000.

Kelso, Wash.—A resolution has been passed for paving the principal streets of this city.

Lexington, Ky.—Ordinances have been passed providing for brick paving, concrete sidewalks and sewers in a number of streets.

Lewiston, Idaho.—City council has authorized the preparation of estimates for about 1 mi. of paving in the eastern section of this city.

Belmont, O.—Special.—Plans, specifications and estimates have been prepared for grading, setting curb and paving with vitrified brick, 5,600 lin. ft. of streets and public road. The contract for the work will be let in August. Harry E. Rice, cons. engr., Barnesville, O.

CONTRACTS TO BE LET.

De Pere, Wis.—Bids are asked until Aug. 19 for paving Broadway.

Grand Forks, N. D.—Bids are asked until Aug. 7 for grading 2 miles of highway. Co. audt.

Danville, Ind.—Bids are asked until Aug. 2 for constructing a gravel road. H. Nichols, co. audt.

Euclid, O.—Bids are asked until Aug. 9 for improving Chardon road. Nelson J. Brown, vil. clk.

Fowler, Ind.—Bids are asked until Aug. 3 for constructing 5 stone roads. Lemuel Shipman, co. audt.

Spencer, Ind.—Bids are asked until Aug. 5 for constructing a pike road. Geo. W. Edwards, co. audt.

Newport, Ind.—Bids are asked until Aug. 5 for constructing 6 gravel roads. H. T. Payne, co. audt.

Shelbyville, Ind.—Bids are asked until Aug. 7 for constructing a road. G. B. Huntington, co. audt.

Columbus, O.—Bids are asked until Aug. 14 for macadamizing 4¼-mis. of road. Walter Braun, co. audt.

Cincinnati, O.—Bids are asked until Aug. 6 for oiling Colerain pike. Fred Dreihs, clk. co. comrs.

Kentland, Ind.—Bids are asked until Aug. 3 for constructing macadam roads. Elmer R. Bringham, co. audt.

Clarinda, Ia.—Bids are asked until Aug. 3 for constructing 5,000 sq. yds. of cement sidewalks. Cy. coun.

Rockville, Ind.—Bids are asked until Aug. 3 for constructing gravel roads. H. A. Henderson, co. audt.

Coitsville, O.—Bids are asked until Aug. 3 for macadamizing Robinson road. J. S. Palmer, clk. bd. trustees.

Green Bay, Wis.—Bids are asked until Aug. 19 for paving N. Broadway st. with cement. Com. on sts. & sidewalks.

Paoli, Ind.—Bids are asked until Aug. 3 for constructing gravel or macadamized roads. Alvin B. Ham, co. audt.

Atlanta, Ga.—Bids are asked until Aug. 9 for paving Decatur st. with creosoted wood blocks. R. M. Clayton, cy. engr.

Crawfordsville, Ind.—Bids are asked until Aug. 3 for constructing a stone road near Alamo. B. B. Engle, co. audt.

Boonville, Ind.—Bids are asked until Aug. 10 for improving 4 streets with macadam. A. J. Batteiger, cy. clk.

Rushville, Ind.—Bids are asked until Aug. 30 for constructing about 3-mis. of macadamized roads. Co. comrs.

Millersburg, O.—Bids are asked until Aug. 12 for 5,000 sq. yds. of brick paving. Samuel Franks, Jr., vil. clk.

St. Paul, Minn.—Bids are asked until Aug. 16 for improving Hamline ave. and Sjostedt road. Edw. G. Kramer, co. audt.

Crown Point, Ind.—Bids are asked until Aug. 9 for constructing concrete sidewalks and repairs. Jacob J. Steeb, town clk.

Hartford City, Ind.—Bids are asked until Aug. 3 for paving 35,775-ft. of road with limestone. W. Lea Smith, co. audt.

Versailles, Ind.—Bids are asked until Aug. 3 for constructing 20,626-ft. of macadamized roads. Nicholas Volz, co. audt.

New Ulm, Minn.—Bids are asked until Aug. 3 for grading, graveling and boulevarding Minnesota st. Ernest Wicherski, cy. clk.

Bayonne, N. J.—Bids are asked until Aug. 3 for paving with Biome granitoid, brick and asphalt. F. W. Dalrymple, cy. engr.

Aberdeen, S. D.—Bids are asked until Aug. 15 for curbing Lincoln, Jay and Kline sts. and 8th ave. F. W. Raymond, cy. adut.

Cincinnati, O.—Bids are asked until Aug. 13 for improving Ohio pike and resurfacing Cleves and Warsaw pikes. Fred Dreihs, clk. co. comrs.

Indianapolis, Ind.—Bids are asked until Aug. 4 for curbing Randolph st. and grading and paving an alley. Jos. T. Elliott, chm. B. P. W.

Gettysburg, Pa.—Bids are asked until Aug. 12 for grading and piking roads in the park. John P. Nicholson, chm. Gettysburg Natl. Park comm.

St. Louis, Mo.—Sealed bids are asked until Aug. 3 for constructing 11-mis. of asphalt, brick, bitulithic, telford, wood block and granite paving. B. P. I.

Albany, N. Y.—Bids are asked until Aug. 6 for repairing and resurfacing State highways. S. Percy Kooker, chm. State highway comm., 53 Lancaster st.

Toledo, O.—Bids are asked until Aug. 2 for macadamizing Dorr st., and until Aug. 3 for repairing Central ave. stone road. D. T. Davies, Jr., co. audt.

Atlantic City, N. J.—Bids are asked until Aug. 4 for grading and macadamizing shore road at Absecon to N. J. ave. Somers Point. E. D. Rightmire, co. engr.

Greenville, Ill.—Bids are asked until Aug. 15 for constructing 15,000 sq. yds. of vitrified brick paving, and combined concrete curb and gutter. J. F. Johnson, cy. clk.

Albion, Ill.—Bids are asked until Aug. 15 for constructing 2½-mis. of vitrified brick paving with stone curb and gutter. Chas. Emerson, chm. bd. local impvts.

Brooklyn, N. Y.—Bids are asked until Aug. 4 for repaving Moffat st. with asphalt, and constructing concrete sidewalks in a large number of streets. Bird S. Coler, boro prest.

Lansdowne, Pa.—Bids are asked until Aug. 6 for constructing 21,000 sq. yds. of Baltimore ave. with bitulithic, repressed vitrified shale or fire clay blocks on concrete base; 7,500 cu. yds. excavation. John W. Davis, secy. boro coun.

Great Falls, Mont.—Bids are asked until Aug. 9 for 13,000 sq. yds. of creosoted wood block paving in First ave. S.; 2,040 cu. yds. concrete; 2,350 cu. yds. earth excavation; 642 lin. ft. headers. C. W. Swearingen, cy. engr.; C. P. Wren, cy. clk.

Madison, Ind.—Bids are asked until Aug. 10 for constructing 6 gravel roads. Wm. D. Richards, co. audt.

New Albany, Ind.—Bids are asked until Aug. 7 for paving Greenaway Place. John C. Short, cy. clk.

Ishpeming, Mich.—Bids are asked until Aug. 3 for constructing 3,100 ft. of concrete sidewalks.

Rushville, Ind.—Bids are asked until Aug. 30 for constructing a macadam road. Jesse M. Stone, co. audt.

Bellefontaine, O.—Bids are asked until Aug. 21 for 6,700 sq. yds. of brick paving. Clair A. Inskeep, cy. engr.

Crown Point, Ind.—Bids are asked until Aug. 9 for constructing concrete sidewalks and repairs. Jacob J. Steeb, town clk.

Indianapolis, Ind.—Bids are asked until Aug. 4 for paving an alley and curbing Randolph st. Jos. T. Elliott, chmn. B. P. W.

Ft. Terry, N. Y.—Bids are asked until Aug. 14 for constructing 9,000 lin. ft. of macadam roads. Capt. Chas. T. Baker, constr. Q. M.

Baltimore, Md.—Bids are asked until Aug. 4 for grading, curbing and paving Stag alley with vitrified brick. B. T. Fendall, cy. engr.

La Grange Park (P. O. La Grange), Ill.—Bids are asked until 8 p. m., Aug. 2, for paving Spring, Waiola, Stone and Brainard aves. with limestone macadam. Bd. local impvts.

Chicago, Ill.—Bids are asked until Aug. 4 for paving 3 streets with granite, 18 streets with asphalt, 2 with vitrified brick, 1 with creosoted wood blocks, 1 with blast furnace slag. C. A. V. Standish, secy. bd. local impvts.

Hoosic Falls, N. Y.—Bids are asked until Aug. 6 for constructing 3,600 sq. yds. of brick paving, 18,000 sq. yds. of macadam paving, 6,000 lin. ft. concrete curb, 2,000 lin. ft. concrete sidewalk. Sanford E. Cluett, secy. pub. impvt. comn.

CONTRACTS AWARDED.

Leechburg, Pa.—The contract for paving with brick was awarded, July 6, to D. K. Hill, for $5,836.

Columbus, O.—A. G. Pugh was awarded the contract for paving several streets, June 28, for $70,000.

San Francisco, Cal.—Flint & Treacy have been awarded the contract for paving S. 2nd st., for $8,492.

Joliet, Ill.—Wm. Moran was awarded the contract for paving S. Chicago st. with brick, for $11,855.

Springfield, Ill.—The contract for paving N. 9th st. was awarded to J. E. Bretz, at $1.33 a sq. yd.

Marietta, O.—L. T. Cislor was awarded the contract, July 14, for paving 1-mi. of Hildreth road with brick, for $15,490.

Hackensack, N. J.—The contract for constructing the Belleville turnpike was awarded to Edw. P. O'Neill, for $26,372.

Ashtabula, O.—Downs & Campbell, of Canton, O., secured the contract, July 13, for paving Oak st. with brick, for $23,434.

Rochester, N. Y.—The contract for paving East ave. and Edgerton st. was awarded, July 9, to Whitmore, Rauber & Vicinus, for $35,020.

Wichita, Kas.—H. L. Miles was awarded the contract, July 20, for paving E. Douglas ave. with brick, at $1.67 a sq. yd.

New Brunswick, N. J.—The contract for paving 4 streets with Clymer brick was awarded, July 6, to Thomas H. Riddle.

Birmingham, Ala.—The contract for completing the paving in 26th st. was awarded to the Southern Bitulithic Co., July 7.

Brazil, Ind.—The contract for constructing the Swinehart gravel road was awarded to John E. Grider, July 10, for $5,187.

Hampton, Va.—The contract for constructing 3½-mis. of stone road was awarded to G. F. Trice & Co., of this city, for $23,300.

New Albany, Ind.—The contract for improving Market st. with brick was awarded to the Jefferson County Construction Co., at $1.23 a ft.

Elizabeth, N. J.—The contract for constructing the Terrill road was awarded, July 9, to the Henry Weldon Construction Co., for $26,044.

Roanoke, Va.—This city has awarded a contract for constructing cement paving in 15th ave. to C. Markley, of this city, at $1.60 a sq. yd.

Harrisburg, Pa.—The Barber Asphalt Paving Co. submitted the lowest bid for paving Briggs, Zarlor and 17th sts. with asphalt, at $1.68 a sq. yd.

Fulton, Ky.—The contract for paving the streets with gravel was awarded to Charles W. Little, of Caruthersville, Mo., for $40,000.

Piqua, O.—The contract for paving Caldwell st. was awarded, July 14, to J. W. Wace, of Dayton, at 90 cts. a sq. yd. for treated macadam.

Troy, N. Y.—The contract for repairing the asphalt pavements in this city was awarded to the North Hudson Contracting Co., at $2.33 a sq. yd.

Catskill, N. Y.—The contract for paving Main and Bridge sts. with brick was awarded, July 14, to Geo. W. Holdridge, of this city, at $2.29 a sq. yd.

Lawrence, Mass.—The contract for constructing 10,000 sq. yds. of granolithic walks was awarded to Philip Holland, of this city, July 14, at $1.30 a sq. yd.

Baltimore, Md.—The contract for paving 5-mis. of road in Anne Arundel county was awarded, July 12, to Fisher & Corrozza, for $13,253, and 3-mis. in Calvert county, for $11,671.

Grand Island, Neb.—The contract for constructing 31,246 sq. yds. of brick paving was awarded to M. Ford, of Cedar Rapids, July 7, at $2.08 a sq. yd.

Dunmore, Pa.—McConville & Fitzpatrick, of Pottston, Pa., secured the contract for about 1-mi. of paving here, using Nay Aug brick, for $32,722.

Atlantic City, N. J.—The contract for grading and graveling the Chestnut Neck road was awarded to Geo. Hanselman, of Cologne, N. J., for $5,143.

Portland, Ore.—The Warren Construction Co. was awarded the contract for paving 24th st. for $22,459, and J. L. O'Donnell the contract for paving Alberta st. for $11,569.

Clinton, Ind.—The contract for constructing 250,000 sq. ft. of cement sidewalk was awarded, July 15, to Pierson & Kinser, of Terre Haute, Ind., at 6½ cts. a sq. ft.

Grand Forks, N. D.—The contract for paving International ave. with Donnellite was awarded to P. McDonnell, of Duluth, for $55,881.

Ogden, Utah.—The contract for street paving in Dist. 100 was awarded, July 19, to P. J. Moran, of Salt Lake City, for $107,096.

Bloomington, Ill.—The contract for paving Clay st. with brick with combined concrete curb and gutter was awarded, July 26, to I. D. Lain, at $1.81 a sq. yd. for paving; 49 cts. a lin. ft. for curb and gutter; c. i. inlets, $11 each; pipe inlets, 40 cts.; resetting curb, 11 cts. a lin. ft.; relaying old brick paving, 38 cts. a sq. yd.

Davenport, Ia.—The contract for paving 8th, 13th and Brown sts. with brick was awarded, July 6, to the McCarthy Improvement Co., at prices ranging from $1.45 to $1.50 a sq. yd.

Galveston, Tex.—Kelsi & Vautrin, of this city, secured the contract for paving Avenue E with vitrified brick with asphalt filler, for $18,826, or with cement grout filler, for $17,526.

East Palestine, O.—McLane & Armstrong, of Lisbon, secured the contract for constructing State highway "D," using concrete foundation and Minerva or Medal block, for $18,000.

Evansville, Ind.—The contract for paving Main st. with asphalt was awarded to the Frankfort Construction Co., of Frankfort, Ind., July 12, at $1.86 a sq. yd.; total, $22,000.

Camden, N. J.—J. F. Shanley & Co., of Philadelphia, secured the contract, July 12, for constructing 2¼-mis. of stone road of either Amiesite or asphalt macadam, for $24,061.

Catskill, N. Y.—George W. Holdridge, city, was awarded the contract for paving Main and Bridge sts. with brick, for $10,770, including electric railway space, or $9,389 omitting railway space.

Mason City, Ia.—The contract for constructing 21 blocks of cement-concrete paving was awarded to M. Tschirgi & Sons, of Dubuque, at $1.19 a sq. yd. for the street paving and $1.26 for alley paving.

Middletown, O.—J. E. Conley, of Dayton, was awarded the contract for paving 4th st. with vitrified brick, for $27,305.45. F. M. Kemp was awarded the contract for paving Middletown alley, for $1,902.

Chattanooga, Tenn.—The Southern Paving & Construction Co., of this city, was awarded the contract for constructing asphalt resurfacing and new asphalt paving in Georgia ave., 11th, A and Columbia sts., for $25,500.

Buffalo, N. Y.—The contract for macadamizing Hamburg turnpike was awarded to F. V. E. Bardol, in 2 sections for $75,000 and $31,400, respectively, and the 3rd section to the Thos. Brown Construction Co., for $4,830.

Wellington, Kas.—The contract for asphalt paving in Washington, Harvey and Lincoln aves. was awarded to the Kaw Valley Paving Co., of Topeka, for $98,467 for Conveto asphalt, and $99,873 for sheet asphalt.

Greencastle, Ind.—The contract for pav-

ing Seminary st. with concrete sidewalks, curbing and gutters, and brick street and alley crossings was awarded, July 10, to George T. Miller, of Lebanon, Ind., for $7,938.31.

Mishawaka, Ind.—The Western Construction Co., of Chicago, was awarded contracts, July 8, for paving W. Joseph and W. 2nd sts. with asphalt, and H. W. Reed & Sons, of this city, the contract for paving Union st. with bitulithic.

West mount, Canada.—Cairnie & Co. secured the contract, July 13, for constructing sidewalks during the year, at 25 cts. a sq. ft., and Morsen & Co., the contract for gutters, at 52½ cts., and gutters and channel at 69 cts. a sq. ft.

Oakland, Cal.—The contract for paving 4th ave. from E. 18th st. to Clinton ave., 20 blocks, with bitulithic, was awarded to the Ransome-Crummy Construction Co. This is a private contract awarded by F. M. Smith, a capitalist of East Oakland.

Boston, Mass.—John E. Burns was awarded the contract, July 20, for paving 7 streets in Roxbury with brick blocks, for $46,535.40. James Doherty secured the contract for wood block paving in Bowdin and Quincy sts., Dorchester, for $5,603.77.

Jacksonville, Fla.—The contract for constructing 37,687 sq. yds. of brick paving was awarded, July 6, to the Southern Clay Mfg. Co., of this city; 40,381 sq. yds. of vitrified brick paving, Georgia Engineering Co., of Augusta, Ga.

Canton, Ill.—Contracts for paving hard roads were awarded, July 12, as follows: Dist. No. 3, Savill & Carney, exca., 40 cts. a cu. yd.; pavement, $1.41 a sq. yd. Dist. No. 4, M. Heckard & Son, exca., 37 cts, a cu. yd.; pavement, $1.42 a sq. yd.

Longport, N. J.—The contract for constructing a new boardwalk to connect with that of Atlantic City, Ventnor and Margaret City, making 12-mis. of continuous boardwalk, was awarded, July 1, to the Cooney Construction Co., of Atlantic City, for $10,000.

Kentland, Ind.—The contract for constructing macadam roads in Jefferson twp. was awarded, July 6, to W. F. Smith & Co., of Rensselaer, Ind., Barnes & Son, of Logansport, Jas. Couch, of Kentland, and H. L. Simmons, of Kentland, for $17,474.

Utica, N. Y.—The contract for constructing brick paving in Shaw st. was awarded to J. W. Johnston, July 6, at $2.40 a sq. yd. Bids for constructing the Utica Parkway, from Genesee to Elm sts., 16,000 sq. yds., with bituminous macadam, were submitted, July 15, as follows: Utica Engineering & Construction Co., $28,245; J. E. Martin, of Poughkeepsie, $30,350; Barber Asphalt Paving Co., $25,609; Newport Construction Co., $24,601; John R. Baxter, Jr., $24,976; Harry W. Roberts & Co., $25,873; for bituminous macadam, $22,399; Warren Bros., $30,871.

Saginaw, Mich.—The Cleveland Trinidad Paving Co., of Cleveland, O., was awarded the contract, July 8, for paving Cherry, Germania, Park, Adams, Fayette, Cass and Woodbridge sts. with asphalt. John C. Davies was awarded the contract for paving Cherry st. with brick, and W. N. Sager the contract for paving Cass st. with brick.

Muskogee, Okla.—The Cleveland Trinidad Co., of Trinidad, O., was awarded the contract, July 6, for 2,540 sq. yds. of sheet asphalt pavement, at $2.03 per sq. yd.; and to the Davies Construction Co. for 2,700 cu. yds. class "A" and 2,700 cu. yds. class "B" excav. at 35 cts. and 90 cts. respectively, per cu. yd., and for 510 sq. yds. brick paving at $1.94 per sq. yd.

New York City.—The Hastings Pavement Co. submitted the lowest bid, July 13, for paving Fulton ave. with asphalt block as follows: 13,725 sq. yds. completed asphalt block pavement, and keeping same in repair for 5 years from date of acceptance, $1.84; 2,165 cu. yds. concrete, including mortar bed, $6; 1,700 lin. ft. new curb, furnished and set in concrete, $1.05; 5,430 lin. ft. old curb, rejointed, recut on top and reset in concrete, 35 cts.; total, $41,020. This company was also the lowest bidder for other streets in Bronx boro, as follows: Contract 11, Elsmere Pl., $4,324; Contract 12, E. 135th st., $8,410; Contract 6, Courtlandt ave., $6,669; Contract 8, Hoe ave., $14,555. The Barber Asphalt Co. submitted the lowest bid, July 13, for repaving Park ave. with asphalt blocks, as follows: 28,600 sq. yds. completed asphalt block pavement and keeping same in repair for 5 years from date of acceptance, $1.77; 3,610 cu. ft. concrete, including mortar bed, $6; 300 lin. ft. new curb, furnished and set in concrete, 98 cts; 400 lin. ft. old curb, rejoined, recut on top and reset in concrete, 55 cts.; 28,590 sq. yds. old paving blocks, to be purchased and removed by contractor, 1 ct., the amount bid for this item will be deducted from the payment on acceptance; total, $72,510.

SEWERS.

Mt. Vernon, N. Y.—The Rider & Starr Sewage Disposal & Construction Co. has been incorporated to gather and dispose of garbage, by O. F. Starr, T. C. Rider and E. A. Robinson.

CONTEMPLATED WORK.

Joplin, Mo.—A concrete sewer in 10th st. is contemplated.

Hamilton, Mont.—Plans for a sewerage system will be prepared.

Madison, Fla.—Voted to issue $35,000 for constructing sewers here.

Mt. Vernon, Wash.—The construction of a sewerage system is contemplated.

Clinton, Okla.—City council has authorized the issue of $25,000 sewer bonds.

Peoria, Ill.—Plans are to be prepared for constructing a sewer to drain the south end. Clay Balsley, cy. engr.

Joliet, Ill.—Petitions are being circulated asking for the construction of a large sewerage system. H. A. Stevens, cy. engr.

Lake City, Ia.—Plans have been prepared for 2,000-ft. of 8 to 18-in. sewers.

Batavia, N. Y.—Voted to issue $375,000 bonds for constructing a sewerage system.

Elizabethton, Tenn.—Voted to issue bonds for constructing 15,000-ft. of sewers.

Beverly, N. J.—The question of constructing a sewerage system is being agitated.

Clinton, Ill.—The construction of 5,500-ft. of 6 and 10-in. sewer is contemplated.

Dover, Del.—(Special). This city is about to let a contract for constructing sewers.

North Toronto, Ont.—Voted July 17 to issue $140,000 bonds for constructing a sewerage system.

South Amboy, N. J.—Plans for a sewerage system are being prepared. Jos. F. Fulton, cy. clk.

Davenport, Ia.—Will vote Aug. 9 on the issue of bonds for constructing a sewer in Bettendorf.

Traverse City, Mich.—Will vote on the question of issuing bonds for constructing a sewage disposal plant.

Norton, Kas.—Plans and specifications are being prepared for constructing a complete sewerage system.

Moundsville, W. Va.—Will vote Aug. 14 on the question of issuing bonds for constructing a sewerage system.

Des Moines, Ia.—The construction of a 3-mi. sewer system north of Ingersoll Park this year is contemplated.

Oklahoma City, Okla.—The construction of storm sewers at a cost of $181,405 has been recommended by W. C. Burke, cy. engr.

Springfield, O.—The construction of a main sewer in Race st. and a sanitary sewer in Jackson and Clark sts. is contemplated.

Lafayette, Ind.—A resolution has been adopted providing for the construction of a sewer. Edgar H. Andress, Jr., clk. B. P. W.

Dormont, Pa.—(Special). G. J. Shaffer says the borough council is interested in the question of a sewage disposal plant, etc.

Bushnell, Ill.—Cephas Holmes, of Macomb, has been engaged to prepare plans and specifications for a sewerage system here. Mayor Harris.

Anderson, Ind.—Plans and specifications have been authorized and bids will be asked for constructing 1-mi. of sewer in the west end.

East Hartford, Conn.—The East Hartford fire district has authorized the construction of 1,875-ft. of 4-in. pipe sewer in Roberts st.

Indianapolis, Ind.—The estimated cost of the proposed sewerage system west of Belmont ave. between the Sellers farm and Haughville is $200,000.

Anniston, Ala.—A resolution has been passed for constructing a sanitary sewer in Blue Mountain ave. and E. 16th st. J. L. Wikle, mayor.

Carlisle, Pa.—(Special). C. A. Bingham, borough engineer, advises us that he is preparing plans for 5,600-ft. of intercepting storm sewer.

Canby, Minn.—New plans and specifications for a sewerage system will be prepared and new bids asked for construction. M. S. Nelson, mayor.

Chickasha, Okla.—(Special). Elmer S. Colby, cy. engr., advises us that he has prepared plans and estimates for storm sewers and 4-mis. of sanitary seewrs.

Holton, Kas.—(Special). This city has engaged William C. Bryant, of this city, to prepare plans and specifications for constructing a complete sewerage system.

Lake Charles, La.—Will vote Aug. 10 for the purpose of choosing 5 members of the proposed sewerage board, which is to take up the question of a sewerage system.

Carthage, O.—The construction of a complete sewerage system on separate plans with sewage purification works is under consideration by the State bd. of health.

Cuthbert, Ga.—(Special). The mayor and council has been authorized to investigate the probable cost of a system of sewerage. Robert L. Moyer, secy. Board of Trade.

Wichita, Kas.—Plans and specifications have been submitted to the city comrs. for the College Hill sanitary sewer, which will require 77-mis. of mains and laterals, and will cost $400,000.

Tarboro, N. C.—(Special). R. A. Zoeller desires information regarding systems for the purification of sewage from private residences and towns, and will be in the market for such a plant soon.

Flushing (L. I.), N. Y.—The bd. of est. has adopted a plan for a 6-ft. sewer main to run from Oak st. 1½-mi. across lowlying meadows to a point where a branch of Mill creek unites with Flushing creek, where a settling basin will be built.

Atlanta, Ga.—Rudolph Hering, cons. engr., of New York City, has submitted a preliminary report on the proposed sewerage system for this city. He estimates the cost at $1,670,000 for the necessary work, including 3 septic tanks, extension of trunk sewers, building laterals and erecting pumping stations. R. M. Clayton, cy. engr.

Rocky Mount, N. C.—(Special). A. S. Lyons, supt. B. P. W., says the last legislature ordered this city to install a sewage purification plant on account of another city 150-mis. below taking its public water supply from the stream in which this city dumps its sewage. Information regarding the approximate cost of such a plant is desired.

CONTRACTS TO BE LET.

Augusta, Ga.—Bids are asked until Aug. 17 for constructing Beaver ditch. Canal and river com'n.

Chandler, Okla.—Bids are asked until Aug. 3 for constructing a sewerage system. J. A. McLoughlin, mayor.

Boise, Idaho—Bids are asked until Aug. 12 for constructing sewers, etc., in lateral sewer dist. No. 8.

Ames, Ia.—Bids are asked until Aug. 9 for constructing 1,500-ft. of sanitary sewer. A. B. Maxwell, cy. clk.

Estherville, Ia.—Bids are asked until Aug. 5 for establishing county ditches Nos. 50 and 51. Co. bd.

Dakota City, Ia.—Bids are asked until Aug. 4 for constructing joint drainage ditch No. 2. Co. bd.

Ishpeming, Mich.—Bids are asked until Aug. 4 for constructing 300-ft. of 6-in. lateral sewers. B. P. W.

Aberdeen, Wash.—Bids are asked until Aug. 5 for constructing a sewer in sewer dist. F. P. F. Clark, cy. clk.

Charlotte, Mich.—Bids are asked until Aug. 6 for constructing the Getter drain. John B. Rudesill, co. drain comr.

Baudette, Minn.—Bids are asked until Aug. 6 for constructing sewer lines and septic tank. S. M. Koefed, vil. recdr.

Portsmouth, Va.—Bids are asked until Aug. 5 for furnishing and distributing 836-ft. 24 to 36-in. pipe. Bascon Sykes, cy. engr.

Des Moines, Ia.—Bids are asked until August 4 for constructing sewers. Geo. F. Poormann, cy. clk.

Indianapolis, Ind.—Bids are asked until Aug. 2 for constructing local sewers. Jos. T. Elliott, chm. B. P. W.

Fort Dodge, Ia.—Bids are asked until Aug. 9 for constructing a sewer with 10 catchbasins. King E. Beal, cy. clk.

Prophetstown, Ill.—Bids are asked until Aug. 3 for constructing 2-mis. of sewers. Wyman Smith, chm. bd. local impvts.

Boise, Idaho.—Bids are asked until Aug. 12 for constructing lateral sewer, manholes, etc. D. D. Williams, pres. bd. local impvts.

Bloomington, Ill.—Bids are asked until Aug. 5 for constructing a 12-in. sewer in Clay st. R. L. Carlock, chmn. bd. local impvts.

San Antonio, Tex.—Bids are asked until Aug. 9 for constructing Prospect Hill sewer system in impvt. dist. No. 7. Fred Fries, cy. clk.

Crookston, Minn.—Bids are asked until Aug. 10 for repairing and rebuilding the 3rd st. sewer outlet in sewer dist. No. 1. A. M. Childs, cy. clk.

Newberry, S. C.—Bids are asked until Aug. 10 for constructing extensions to the sewerage and water works systems. M. L. Spearman, chm. comrs. pub. wks.

Crookston, Minn.—Bids are asked until Aug. 10 for repairing and rebuilding the 3rd st. outlet in sewer dist. No. 1. A. M. Childs, cy. clk.

Iowa Falls, Ia.—Bids are asked until Aug. 2 for constructing 6½-blocks of 8-in. sanitary sewer and 2 water main extensions. F. E. Foster, cy. clk.

Hopkinsville, Ky.—Bids are asked until Aug. 3 for constructing a septic tank at

Western Ky. asylum for insane. Albert Scott, prest. Ky. asylum.

Louisville, Ky.—Bids are asked until Aug. 6 for constructing section B of Western interceptor contract 49. J. B. F. Breed, ch. engr.

Evansville, Ind.—Bids are asked until Aug. 7 for constructing 3 vitrified pipe sewer laterals. Walter F. Wunderlich, clk. B. P. W.

Scottsbluff, Neb.—Bids are asked until Aug. 5 for constructing the irrigation canal extension. Tri-State Land Co., Scottsbluff, Neb.

Rahway, N. J.—Bids are asked until Aug. 3 for constructing 4,300-ft. of vitrified tile sewers with laterals, manholes and basins. Franklin Marsh, cy. engr.

Cloquet, Minn.—Bids are asked until Aug. 16 for constructing 4,900-ft. of 8-in. sewer with appurtenances, and 5,230-ft. of 6-in. water main. Jos. Loisel, cy. clk.

Monticello, Ark.—Bids are asked until Aug. 5 for constructing 7-mis. of 8 to 12-in. sewers, with 2 purification plants. Walter G. Kirkpatrick, cons. engr., Jackson, Miss.

Mt. Carmel, Ill.—Bids are asked until 3 p. m., Aug. 2, for constructing a sanitary sewerage system, all vitrified sewer pipe ranging from 6 to 8-ins. Guy W. Courter, cy. engr.

Rogers, Ark.—Bids are asked until Sept. 1 for constructing 30,000-ft. 8-in., 1,700-ft. 10-in., and 3,000-ft. 12-in. sewers; 58 manholes; 10 flush tanks; 1,154 Y's; 1 septic tank for disposal. Bd. sewer comrs.

Cincinnati, O.—Bids are asked until Aug. 9 for improving trunk sewer in streets and right of way west of Harrison ave., north and south of Montana ave., and building a 24-in. sewer through right of way east of Harrison ave. south of Montana ave., Westwood. John J. Wenner, clk. B. P. S.

Albert Lea, Minn.—Bids are asked until Aug. 19 for constructing a trunk sewer with concrete retaining wall at outlet; 9 manholes; sewage lift and pumping machinery; 2,500-cu. yds. earth embankment; 6 storm water inlets; 3 storm water catchbasins; concrete inlet, etc. C. J. Dudley, cy. clk.

CONTRACTS AWARDED.

Lexington, Ky.—Thos. O'Day was awarded the contract, July 16, for constructing a sewer in W. 4th st.

Virginia, Minn.—G. C. Butler was awarded the contract for constructing a sewer in Brach st. for $2,749.

Litchfield, Ill.—The contract for constructing sewers was awarded to J. E. Carine, of Murphysboro, for $19,000.

Pierre, S. D.—The contract for constructing sewers was awarded to McMillen & Curran, of St. Pierre, for $11,060.

Niagara Falls, N. Y.—Tierney & Horn have sublet the contract for constructing a trunk sewer to Richard O'Leary for $70,000.

Westfield, N. J.—The contract for constructing sewers was awarded to Walter S. French, of Moorestown, N. J., July 6, for $19,675.

Pittston, Pa.—McConville & Fitzpatrick, of this city, secured the contract for constructing a sewer in Market st. for $2,200.

Rugby, N. D.—The contract for constructing a sewerage system was awarded to Jas. Kennedy, of Fargo, N. D., for $12,679.

Williston, N. D.—The contract for constructing a sewerage system was awarded to Chas. H. Porritt, of Fargo, N. D., for $42,000.

Ensley, Ala.—C. M. Burkhalter & Co. secured the contract for constructing the extension of the storm sewer in Avenue H for $12,000.

Middletown, O.—The contract for constructing the Lakeside trunk sewer was awarded, July 9, to Paul & Kirschner, of Dayton, for $14,096.75.

Titusville, Pa.—The contract for constructing a sewer in Brown, E. Elm and Chestnut sts. was awarded to Burns Bros., of New Castle, for $8,728.

Ft. Worth, Tex.—The contract for constructing 17-mis. of sewers was awarded to the General Supply & Construction Co., of this city, for $100,000.

Cleveland, O.—The contract for constructing the intercepting sewer between Marquette st. NE and E. 61st. st. was awarded to Wm. Lehman, for $47,168.

Auburn, Neb.—The contract for constructing a sewerage and water-works system was awarded to the Katz-Kraig Construction Co., of Omaha, for $61,782.79.

Albuquerque, N. Mex.—The contract for constructing a sewerage system was awarded, July 10, to Glass & Fischer, of Bakersfield, Cal., for about $260,000.

Buffalo, N. Y.—Bids for constructing a brick sewer in Fillmore ave. were submitted July 16 as follows: Spiess & Fanning, $21,000; John Miller, $22,000; B. F. Spire, $21,900.

Louisville, Ky.—The contract for constructing section B of the southern outfall sewer in South Louisville was awarded, July 9, to C. T. McCracken & Co., of Columbus, O., for $80,000.

San Francisco, Cal.—Sewer contracts were awarded, July 9, as follows: 5th st., Healy-Tibbitts Constr. Co., 268 Market st., $28,359; Greenwich and Octavia sts., G. W. McGin & Co., $7,710.

Salt Lake City, Utah.—Special.—Bids were submitted July 2 for sewer extension No. 218, as follows: Davis & Heuser Constr. Co., $885.52; H. G. Gilkerson, $926.97; J. D. Hanley, $932.15.

Marinette, Wis.—The contract for constructing sewers in White and Blaine sts. and Elizabeth ave. alley and Parkridge ave. was awarded, July 12, to John Striffler, for $6,195. Mulholland & Sons secured the contract for a sewer in 3rd st. for $4,873.16.

Liberty, Mo.—The contract for sewer work was awarded, July 16, as follows: R. J. & W. M. Boyd Construction Co., 200 Southwest Boulevard, Kansas City, Mo., District No. 1; Michael Walsh, Kansas City, District No. 2; A. D. Johnson Construction Co., Kansas City, District No. 3; Edgar Main, Liberty, District No. 4. E. H. Collins, Liberty, is engr.

Detroit, Mich.—Bids for constructing sewers were submitted July 16, as follows: Cameron ave. sewer, $9,075, by Geo. Winterhalter; Vinewood ave., $4,521, by J. A. Mercier; Linwood ave. sewer, $4,442, by Wm. Porath; 31st st. sewer, $12,760, also by Wm. Porath, and Central ave. sewer, for $44,610, by Jas. Hanley.

Mitchell, S. D.—Bids for constructing sewers were submitted, as follows: Fenebust & Sons, Sioux Falls, S. D., $38,934; Ilstrup & Olson, Minneapolis, $61,554; Tanner Bros., Webster, S. D., $55,378; Jas. Kennedy, Fargo, N. D., $56,416; O. F. Doyle, St. Cloud, Minn., $52,552, all using concrete and vitrified pipe, except Fenebust & Sons, who proposed No. 2 vitrified pipe with concrete.

WATER WORKS.

Waco, Tex.—The Rotan Water and Light Co. has been incorporated by Henry K. Meherg, D. Comyn Moore, C. Hamilton, E. Rotan and C. H. Sharman.

New Orleans, La.—An opinion rendered by Dillon & Hubbard, attorneys, of New York City, holds the recent bond issue of the sewerage and water board of this city perfectly legal.

CONTEMPLATED WORK.

Foley, Minn.—A water works system is contemplated.

Bowman, N. D.—Plans for a water works system have been accepted.

Peru, Neb.—A municipal water works system is contemplated.

Caddo, Okla.—This city contemplates the constructing of a water works system.

Cranston, R. I.—The citizens of Oaklawn are discussing the question of a water supply.

Kent, Wash.—Voted to issue $70,000 for constructing 7 mis. of new water works system.

Collingwood, N. J.—The construction of a municipal water works system is proposed.

Quincy, Fla.—It is proposed to expend $36,000 for extending the water works system.

LeRoy, N. Y.—The bd. of water commissioners are planning to increase the water supply.

Apple Creek, O.—Plans for a public water works system have been approved by the state bd. of health.

Blackwell, Okla.—The extension of the water works system at a cost of $30,000 is contemplated.

Las Vegas, Nev.—The Las Vegas Land and Water Co. contemplates improvements in the water works system.

Wilbur, Wash.—Voted to issue $4,100 bonds for replacing old wooden water mains with new iron mains.

Arvada, Colo.—Will vote Aug. 17 on the question of issuing $40,000 bonds for constructing a water works system.

Dodge City, Kans.—Will vote Aug. 10 on the question of issuing bonds for constructing a water works system.

Merchantville, N. J.—The question of constructing a water works system is under consideration. Mayor Longstreth.

Morristown, N. Y.—E. D. Smalley, C. E., of Syracuse, estimates the cost of a water works system for this town at $15,000.

Junction City, Kas.—The plans and specifications for reconstructing the water works system at Fort Riley are about completed.

Alba, Tex.—This city will expend $20,000 for improvements to the water works system, including tank on steel tower and 4-in. water mains.

Binghamton (Memphis P. O.), Tenn.—This city has issued $40,000 bonds for constructing a water works and sewerage system. Chas. A. Price, chmn. sewer and water comn.

Brewer, Me.—The citizens will hold a mass meeting Aug. 6 to consider the proposed water proposition before it comes up for vote at the election to be held Aug. 16.

Cuthbert, Ga.—Special.—Robert L. Moyer, secy. board of trade, says the mayor and council have been directed to investigate the probable cost of drilling one or more artesian wells for enlarging the water works system.

Lisbon Falls, Me.—The question of constructing a water works system is under discussion, and George W. Beals, W. A. Hollis and Fred Harding have been appointed a commission, to be known as the Lisbon Falls Water Commission, to investigate as to a source of supply.

Chickasha, Okla.—Special.—Elmer G. Colby, cy. engr., is preparing plans and estimates of cost for the improvement and extension of the water works system by installing one turbine pump, filter, clear water reservoir, standpipe and 11.6 mis. of 6-in. water mains.

Johnson City, Tenn.—Special.—Plans for a new municipal water works system will be prepared by W. M. Dunlap, cy. engr., and Walter G. Kirkpatrick, cons. engr., of Jackson, Miss. A gravity supply from springs, with reservoir and distributing mains, at a probable cost of about $250,000, is proposed.

Defiance, O.—The Defiance Water Co. had Nicholas Hill, Jr., cons. engr., of New York City, to come here recently to investigate the feasibility of piping water to Defiance from the fountain spring region in Mark and Farmer twps., 12 mis. distant. He will also investigate the feasibility of a filtration plant.

Oak Park, Ill.—The village trustees have passed an ordinance creating a municipal water department, which may ultimately absorb the Chicago & Suburban Water and Light Co. The department will supervise an extension of the water mains in this village so as to give service to the residents in the extreme north and south portions, at a cost of $150,000.

Chattanooga, Tenn. — Special. — The water works commission has engaged Walter G. Kirkpatrick, Jackson, Miss., to prepare plans and specifications for a municipal water works system. The supply will probably be from Tennessee river, with mechanical filtration, pumping to reservoir and gravity distribution, through c. i. water mains. A separate high-level system is also proposed.

Newark, N. J.—This city filed with the state water supply commission, July 9, an application for permission to divert water from the Wanaque river watershed and Passaic river watershed, in Passaic and Sussex counties. The city officials declare this will be absolutely necessary in less than six years, and regard it as the most economical means of providing an additional water supply.

Spokane, Wash.—The council passed a resolution July 14 instructing the corporation counsel to draft an ordinance for the issue of $400,000 bonds to carry out improvements to the water works system, as recommended by water comr. Reuterdahl; instructing the water commissioner to proceed at once with his plans for bettering the water conditions; to give the water commissioner full power in making improvements and in handling his department; advising the board of public works that the council will indorse any scheme it may put into effect for ameliorating poor water conditions.

CONTRACTS TO BE LET.

Bradford, O.—Bids are asked until Aug. 15 for constructing a water works system. H. Brown, vil. clk.

Baudette, Minn.—Bids are asked until Aug. 6 for constructing water works, sewers and electric lights. Vil. clk.

Greenbush, Minn.—Bids are asked until Aug. 10 for constructing 1,200 ft. of water mains. A. F. Kular, vil. clk.

New Ulm, Minn.—Bids are asked until Aug. 3 for constructing water mains in Minnesota st. Ernst Wicherski, cy. clk.

Chicago, Ill.—Bids are asked until Aug. 4 for constructing water service pipes. C. A. V. Standish, secy. bd. local impvts.

Okemah, Okla.—Bids are asked until Aug. 5 for installing a water works and electric light system. P. J. Becker, town clk.

Cloquet, Minn.—Bids are asked until Aug. 16 for laying 5,230 ft. of 6-in. water mains and appurtenances. Jas. Lousel, clk.

Washington, D. C.—Bids are asked until Aug. 7 for furnishing 200 fire hydrants. H. B. F. MacFarland, chmn. dist. comrs.

Newberry, S. C.—Bids are asked until Aug. 10 for the extension of the water and sewer system. M. L. Spearman, chmn. comrs. pub. wks.

Cleveland, O.—Bids are asked until

Aug. 5 for furnishing 40 tons of lead pipe for the water department. W. J. Springborn, prest. B. P. S.

Newark, O.—Bids are asked until Aug. 4 for constructing an infiltration intake for the municipal water works plant. Albert C. Gundlach, clk. B. P. S.

Pierre, S. D.—Bids are asked until Aug. 23 for constructing an artesian well in the capitol grounds. John Hirning, secy. So. Dakota Capitol Comn.

New York City.—Bids are asked until Aug. 4 for constructing water mains in Arlington, Heath, La Salle and McGraw aves. John H. O'Brien, comr. water sup., etc.

Detroit, Mich.—Bids are asked until Sept. 14 for building and erecting three pumping engines at the new pumping station in this city. Benj. F. Guiney, secy. bd. water comrs.

Bloomington, Ill.—Sealed bids are asked until Aug. 5 for constructing 6-in. c. i. water mains in Madison, Beecher and Wood sts. R. L. Carlock, chmn. bd. local impvts.

Brooklyn, N. Y.—Bids are asked until Aug. 4 for constructing water mains and appurtenances in Flatbush ave. extension. John H. O'Brien, comr. water sup., N. Y. City.

Salt Lake City, Utah.—Bids are asked until Aug. 6 for constructing the N. Temple st. aqueduct across W. Temple, First W. and Second W. sts. Louis C. Kelsey, cy. engr.

New Westminster, B. C.—Bids are asked until Aug. 9 for about 74,600 ft. and 16,000 ft. of steel pipe, with inside diameter of 24 and 12 ins., respectively. Cy. clk.

Sunnyside, Wash.—Bids are asked until Aug. 16 for constructing Sulphur Creek wasteway channel and structures near here, including 4¼ mis. of channel. U. S. Reclamation Service, No. Yakima.

Chester, S. C.—Bids are asked until Aug. 3 for furnishing and installing two wood tank gravity filters and turbine pumps, motors, foot valves, gate valves and electrical equipment. James Hamilton, cy. engr.

Lamar, Colo.—Bids are asked until Aug. 9 for constructing sec. Nos. 2 and 3 of the proposed water supply. Sec. No. 2 consists of 9 mis. of vitrified pipe line and No. 3 of a wood covered concrete reservoir. J. F. Curry, town clk.

Glasgow, Mont.—Bids are asked until Aug. 11 for constructing a water works system, including a pumping station complete, 200,000-gal. concrete reservoir, 16,400 ft. 6-in., 4,350 ft. 8-in. pipe and 2,550 ft. wood pipe. Alternate bids will be received on 6 and 8-in. iron and wood pipe. E. S. Severance, cy. engr.

CONTRACTS AWARDED.

Alliance, Neb.—The contract for furnishing a pump at the water works pumping station was awarded to the Prescott Pump Co., for $13,400.

Penfield, N. Y.—The contract for constructing a water works system was awarded, July 7, to Hollis & Shepherd, of Rochester, for $10,440.

Sheboygan, Wis.—The contract for constructing 5,000 ft. of intake pipe was awarded to the Starke Dredge and Dock Co., of Milwaukee, at $7 a lin. ft., or a total of $55,000.

San Francisco, Cal.—The contract for furnishing 1,200 fire hydrants for the auxiliary salt water supply system for fire protection was awarded to the Union Iron Works, at $119.74 each.

Newport, Ky.—Contracts for improvements to the water works system were awarded, July 21, as follows: Installing pumping engine, Platt Iron Works Co., of Dayton, O., $37,077; constructing pipe line, Joseph Gradison, of Cincinnati, $36,791.55; special material and valves, Bourbon Copper and Brass Works, Cincinnati, $1,278.50.

Braintree, Mass.—The contract for furnishing and laying 8,600 ft. 8-in. c. i. water pipe, hydrants, special castings, etc., was awarded to Thos. Whelan & Co., of Quincy, Mass., for $8,745.

Baltimore, Md.—The contract for the pipe line boilers was awarded, July 21, to the Edgemoor Iron Co., of Delaware, for $41,000. This is the second time bids were received for these boilers.

Bowling Green, Ky.—The Roberts Filter Mfg. Co., of Philadelphia, was awarded the contract for constructing a filtration plant, for $10,300, and F. H. Keister, of this city, the contract for housing the filter, for $3,298.

Boston, Mass.—S. Camoia and Frank Williams, of Boston, secured the contract, July 12, for constructing 12,300 ft. of 24-in. c. i. water pipe in Everett, Chelsea and Revere, for $13,197, and 3,900 ft. 16-in. c. i. pipe in Revere, for $3,111.

BRIDGES.

Lawton, Okla.—Bids are asked until Aug. 16 for constructing 9 bridges. Co. comrs.

Springfield, O.—Bids are asked until Aug. 9 for rebuilding a county bridge. Bd. co. comrs.

Lawrenceburg, Ind.—Bids are asked until Aug. 2 for constructing 2 bridges. W. S. Fagaly, co. audt.

Crawfordsville, Ind.—Bids are asked until Aug. 3 for constructing a bridge. B. B. Engle, co. audt.

Topeka, Kans.—Cy. Engr. Rogers is preparing plans and specifications for the Ward creek bridge.

Boonville, Ind.—Bids are asked until Aug. 3 for constructing a steel bridge. Roy F. Cherry, co. audt.

Jackson, O.—Bids are asked until Aug. 12 for constructing concrete arch bridges. W. J. Shumate, co. audt.

Otterbein, Ind.—Bids are asked until Aug. 14 for constructing 2 bridges. Fred F. Killin, trustee Bolivar twp.

Columbus, Ind.—Bids are asked until Aug. 2 for constructing a concrete arch over Lines ditch. J. M. Davis, co. audt.

Fargo, N. D.—Bids are asked until Aug. 11 for repairing and constructing a number of bridges. Arthur G. Lewis, co. audt.

Albany, Ga.—The county commissioners are considering the question of replacing all wooden bridges with iron or concrete spans.

Council Bluffs, Ia.—New concrete bridges will probably be built across Indian creek, at 8th and Benton sts. Cy. clk. Casady.

Covington, Ind.—Bids are asked until Aug. 3 for constructing 3 bridges and repairing one bridge. W. B. Gray, co. audt.

Plymouth, Ind.—Bids are asked until Aug. 3 for constructing an iron bridge and concrete abutments. C. M. Walker, co. audt.

Sunbury, Pa.—Bids are asked until Aug. 3 for erecting a bridge at Liberty st., in Shamokin. E. W. Young, clk. to co. comrs.

Delphi, Ind.—Bids are asked until Aug. 2 for constructing an approach to a bridge in Rock Creek twp. M. G. Haun, co. audt.

Oakland, Cal.—Bids are asked until Aug. 11 for constructing a concrete culvert in Glen Echo creek, at Grand ave. Walter B. Fawcett, secy. B. P. W.

Chambersburg, Pa.—Bids are asked until Aug. 6 for constructing a reinforced concrete bridge over Back creek, at Hun-

secker's fording. J. Al Cook, chmn. co. comrs.

Carlisle, Pa.—Special.—C. A. Bingham, borough engineer, is preparing plans for a 142-ft. reinforced concrete bridge for the county commissioners.

Zanesville, O.—Bids are asked until Aug. 2 for erecting the substructure of a highway bridge at Moody's Crossing, in Newton twp. L. E. Breisford, co. audt.

Phoenix, Ariz.—Bids are asked until Aug. 16 for constructing a reinforced concrete bridge over Salt river. Bd. supvrs.; L. G. Knipe and B. L. Davis, engrs.

Allentown, Pa.—Bids are asked until Aug. 9 for repairs and alterations to be made to the bridge over Jordan creek, at Sieger's Mill. A. E. Bittner, chmn. co. comrs.

Rumford, Me.—Bids are asked until Aug. 17 for constructing a bridge over Androscoggin river, about 600 ft. long and requiring 700 cu. yds. of masonry. Bd. selectmen.

Hutchinson, Kans.—Special.—G. L. McLane, cy. engr., says this city voted, July 20, to construct a reinforced concrete bridge over Cow creek, at Main and Avenue A.

Baltimore, Md.—Plans have been prepared for a bridge over Jones Falls, at Pratt st. The plans provide for a single span of concrete, with concrete coping, and will cost about $90,000.

Asheville, N. C.—The bd. of co. comrs. has decided to ask for plans, specifications and bids for constructing a bridge at Park ave., across the French Broad river. J. E. Rankin, chmn.

Logansport, Ind.—Bids are asked until Aug. 3 for constructing concrete abutments for 2 steel bridges, constructing 14 ft. of reinforced concrete culvert and 2 steel truss bridges with concrete floor and abutments. Geo. W. Cann, co. audt.

STREET LIGHTING.

Madison, N. J.—The question of a municipal gas plant is being discussed here.

Elburn, Ill.—The construction of an electric light plant is contemplated by the village trustees.

Hydro, Okla.—Will vote soon on the issue of bonds for constructing an electric light plant.

Thibodeaux, La.—The construction of an electric light plant is contemplated by the bd. of aldermen.

Whitesburg, Ky.—The establishment of an electric light plant is contemplated. David C. Mullins is interested.

Boston, Mass.—Bids are asked until Aug. 20 for electrical cable. Col. Edw. Burr, corps engrs., U. S. A.

McMinnville, Ore.—Voted to issue bonds for the completion of the electric light and power plant on Baker creek.

Willshire, O.—The granting of a franchise for installing an electric light plant is under consideration here.

Minneota, Minn.—Plans for the construction of a local electric light plant are under consideration by the citizens.

Kingsville, Tex.—The Kingsville Power Co. has been incorporated by Robert J. Kieberg, H. Delmo and Caesar Kieberg.

Sewickley, Pa.—Bids are asked until Aug. 3 for lighting this borough with electricity. M. Peterson, secy. bd. control.

Tempe, Ariz.—The South Side Gas Co. has decided to construct a gas plant to cost about $50,000. H. L. Chandler, gen. mgr.

Clifton, Tex.—The Clifton Electric Light and Power Co. has been incorporated by J. P. Chambers, W. G. Scarff and A. A. Slaughter.

Osgood, Ind.—F. R. Phillips, supt. municipal electric light plant, is planning to install all-night service and additional turbines.

Grand Rapids, Wis.—The Electric and Water Co. has decided to issue bonds to build a new electric light wiring service and new switchboards.

Fort Pierce, Fla.—Bids are asked until about Oct. 1 for constructing an electric light and power plant for the St. Lucie Ice Co. R. W. Whythe, prest.

Buffalo, N. Y.—The Niagara & Erie Power Co. has been incorporated to conduct an electric light, heat and power plant, by C. F. Blair, M. J. Binkley and E. F. Tideswell, of this city.

Columbus, O.—Bids are asked until Aug. 18 for installing electrical equipment for the county jail, including all lighting fixtures, electric lamps, conduits, wires, etc. John Scott, clk. bd. co. comrs.

Holyoke, Mass.—The bd. of pub. wks. will probably expend $55,000 to enlarge the electric light and water works plant and to extend the electric wires, gas mains and water mains to Smith's Ferry and Kenilworth. W. K. Snow, mgr. municipal power plant.

Ironwood, Mich.—Plans and specifications for the proposed gas works and distribution systems to be installed this summer have been prepared for the Fyfe-Wallace interests, and bids will be received by Henry I. Lea, cons. engr., at his office, The Rookery, Chicago.

Cuthbert, Ga.—Special.—Robert L. Moyer, secy. Board of Trade, says the mayor and council have been authorized to investigate the probable cost of the removal of the power plant from present location to line of railroads, and for enlarging and perfecting the electric and water works systems. D. A. McPherson, mayor.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

Akron, O.—The establishment of garbage disposal works is contemplated.

Atlanta, Ga.—Mayor O'Brien will recommend the immediate purchase of a garbage crematory.

Lawrence, Mass.—The city council contemplates the expenditure of $40,000 for constructing a garbage incinerator.

Canandaigua, N. Y.—The Canandaigua Sanitary Can Co. has been organized and will place cans at private residences and collect garbage.

Indianapolis, Ind.—Mayor Bookwalter has recommended an appropriation of $15,000 more for the continuation of street sprinkling this season.

Moriah, N. Y.—The Destructor Co. has been incorporated for the destruction of refuse, garbage, waste, etc., by Brudish J. Carroll, 111 Broadway; Herbert M. Baldwin, 111 Broadway; Chas. D. Barry, 17 State st.; John R. Bradlee, 17 State st., all of N. Y. City.

PARKS.

Tulsa, Okla.—The city park board has recommended an immediate expenditure of $22,500 for the purchase of city park property for park purposes.

Minneapolis, Minn.—The board of park commissioners will receive designs, detail plans, specifications and estimates for several bridges suitable to the general surroundings of the park system, to connect by waterways the lakes of the park system. The board offers $1,500 in three prizes. Park bd.